

Class RC 971

Book .H 8

Copyright N^o

COPYRIGHT DEPOSIT.

By Woods Hutchinson

THE DOCTOR IN WAR. Illustrated.

CIVILIZATION AND HEALTH.

COMMON DISEASES.

A HAND-BOOK OF HEALTH. Illustrated.

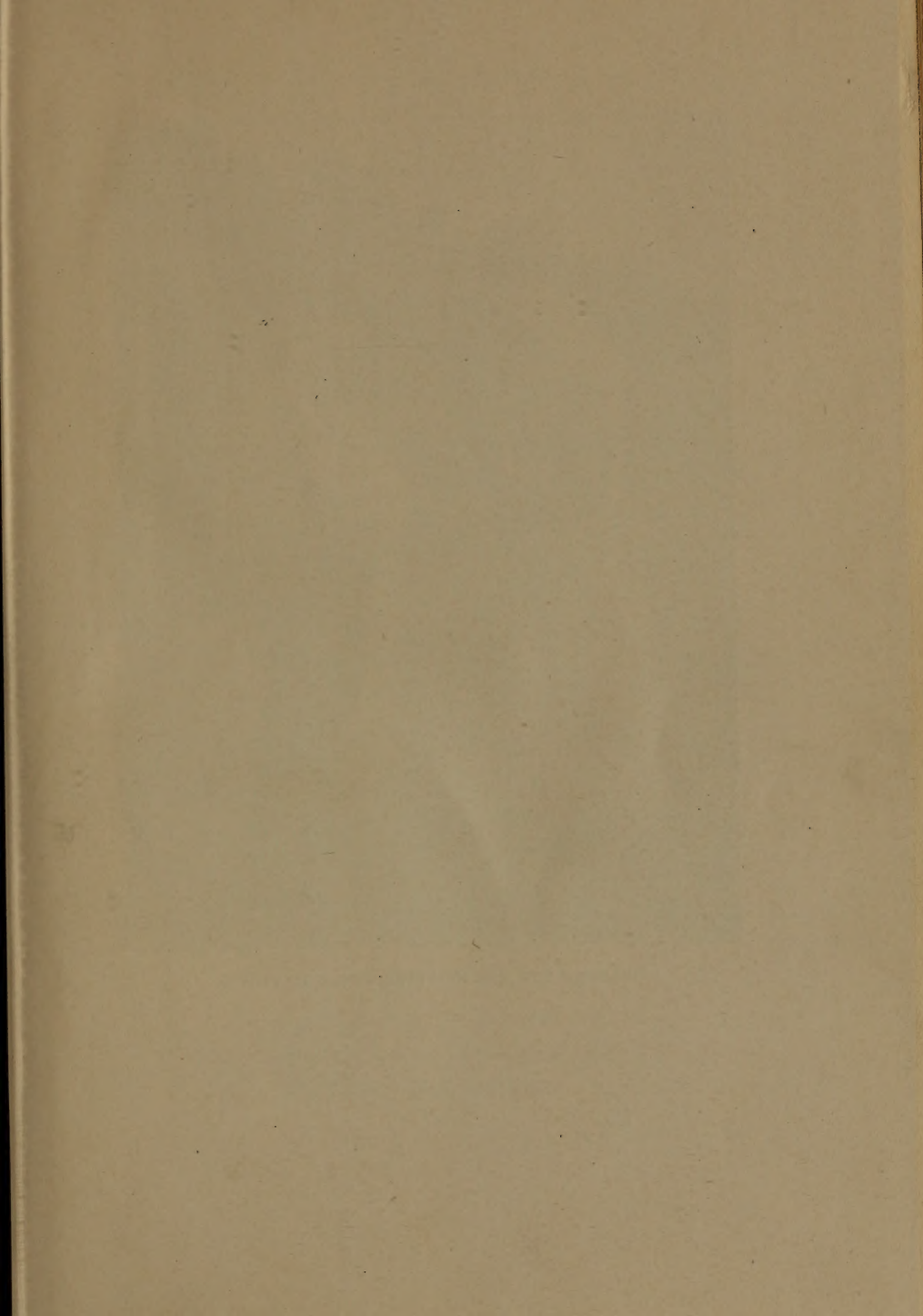
THE CONQUEST OF CONSUMPTION. Illustrated.

PREVENTABLE DISEASES.

HOUGHTON MIFFLIN COMPANY

BOSTON AND NEW YORK

THE DOCTOR IN WAR





WAITING FOR THE HOSPITAL TRAIN TO START

THE DOCTOR IN WAR

By

WOODS HUTCHINSON, M.D.

WITH ILLUSTRATIONS



BOSTON AND NEW YORK
HOUGHTON MIFFLIN COMPANY
The Riverside Press Cambridge
1918

RC971
.H8

COPYRIGHT, 1918, BY WOODS HUTCHINSON

ALL RIGHTS RESERVED

Published November 1918

2.50



DEC -4 1918

©CLA508398

PREFACE

Believing that the doctor and the sanitarian would play an important and by no means discreditable part in this World War, after offering my services to friends on the British Army Medical Staff, only to find that they could not accept any one, save on the terms of taking the oath of allegiance and losing American citizenship, I decided to attempt to visit and study the medical arrangements on the Western Front.

As I had more than half anticipated, I found there the finest and most triumphant demonstration of what modern science can do for the protection of the health and life of an army or a nation ever given in history, equaling if not surpassing the hitherto unrivaled victory of the forces which save life on the Panama Canal.

Thanks to the personal kindness of the Secretary of War, Mr. Baker, and of my friend Colonel Roosevelt, together with the courtesy of my medical colleagues, I secured letters of introduction and papers which made me successful beyond my expectations in securing permission to see almost everything of any value or interest from a medical and public health point of view, from the Base Hospitals up to the Aid Posts in the front-line trenches and from the munition works and Training-Camps to the Hospital Ships and the British Fleet.

I was gone practically a year, from January 15 to December 24, 1917, and spent about three months in England, going and returning, visiting the Base Hospitals, the Training-Camps, the munition factories, and the re-fitting establishments for the blind and the crippled, winding up with a

week's visit to the British Fleet and its Hospital Ships, Ambulance Trains, and Naval Hospitals.

Then I was granted a special permit to visit the medical arrangements of the British Army in France and spent nearly three weeks on the Front tracing the course of the wounded from the front-line trenches through the Dressing-Stations, the Casualty Clearing-Stations, or Field Hospitals, back to the great Base Hospitals, including the huge group Hospital-Camp of 35,000 beds at Étaples, where the Harvard Units are.

The English authorities passed me through to Paris, where I spent nearly six months making frequent trips out to the Hospitals and trenches of the French Front, to Soissons, to Carrel's Hospital at Compiègne, Château-Thierry, the "pays reconquis," the Chemin des Dames, Rheims (twice), the Argonne, Saint-Menehould, Verdun, Alsace; in the intervals visiting the great Paris hospitals, and schools for re-education of the crippled, munition works, sanatoria for tuberculosis, homes for the refugees, and finally spending four days with the Red Cross among the "rapatriés" at Évian.

Early in August I went to the Italian Front, visiting eight or ten of the big War Hospitals in Rome en route, and had a fascinating four weeks on the Isonzo, while the big Italian offensive was under way, which opened so hopefully and ended only a couple of weeks after I left in such a distressing temporary backset. Some of the best hospitals and service for the care of the wounded that I saw anywhere were in Italy, and I formed a very high opinion of the Italian Army and its organization and fighting morale.

Back to Paris in September, where I tried to enlist in our Army Medical Reserve Corps, but found I was too old! —

to my huge disgust; out to our American Zone in France along the foothills of the Vosges, for ten days with our boys in their billets; thence back through the British lines, to visit all our American Hospital Units which were serving in English Hospitals, nine in all, through to London to deliver the Chadwick Lectures on War Hygiene at the Royal Society of Medicine, and complete my visits to the War Hospitals and munition works; and so on home.

It is the first war where the doctor has been given a free hand, and he has responded by almost wiping out disease, making the death-rate from it in the camps lower than that at home, saving ninety per cent of the wounded and sending eighty per cent of them back to the firing-line within forty days! and making the death-rate from all causes in this most horrid-sounding and appalling of wars the lowest on record, barely three per cent per annum, and for the past two years under two per cent.

As a consequence he has become such a valuable part of the fighting force that he has lost all his former immunities. He and his insignia, the Red Cross, as well as his stretcher-bearers and his wounded, are eagerly fired upon by the Huns, who count one doctor worth five hundred soldiers and one stretcher-bearer the equivalent of ten combatants and issue orders to their snipers and machine-gunners accordingly.

He lives under fire, sleeps underground, operates in a gas-mask, and if captured is sent to a prison-camp like a line officer, in flat defiance of all the rules of civilized warfare. He is even contemplating bearing arms to defend himself and his wounded. Blessings (?) on the Hun! !

The courtesies shown me on every hand wherever I went were so constant, so gracious, and so innumerable that it seems almost invidious to mention individual names. If there

are to be found anywhere a body of more kindly, courteous, and considerate men than both the Medical and Line Army officers of the English, French, and Italian commands, it would be difficult for me to imagine them. I must have been an awful nuisance to them sometimes with my requests for visits and information in the hurry and strain of open war, but they never allowed me to see it, and my opinion of war as a school of manners is of the very highest.

But I do feel under special and peculiar obligations, for invaluable and most helpful courteous permissions and assistance, to Sir Alfred Keogh, Director-General of the Royal Army Medical Corps, and to Colonel Horrocks and Major Smales of his staff in England; to General W. G. MacPherson, of the Medical G.H.Q. in France, and Sir George Makins, Consulting Surgeon to the British Armies in France; to Lord Northcliffe and Sir George Riddell, for the splendid opportunities afforded me of visiting the medical arrangements of the British Army both in the Training-Camps and in France; also to Mr. Sidney Walton, of the Ministry of Munitions, and to Colonel John Buchan and Mr. St. John Hutchinson, of the Foreign Office, for most courteous and valued assistance and permission to visit the British Fleet and the great English munition works.

My warmest acknowledgments are also due to our Ambassador in Paris, Mr. William G. Sharp, not only for most helpful official assistance, but for unfailing and constant personal kindness; to M. Justin Godard, Sous-Secrétaire of War for Sanitary and Medical Affairs, and to Surgeon-General Tuffier, of the French Army Medical Corps, for permission and most kindly assistance and facilities in visiting the various Sectors of the French Front.

For my Italian visit and the most liberal facilities af-

PREFACE

ix

forded me on the Isonzo and Trentino Fronts, I owe my most cordial and grateful thanks to the Italian Ambassador in Paris, Marchese Selva di Reggio, and to the Comando Supremo at Udine.

Many of the chapters of the book have previously appeared in magazine and syndicate articles, and I wish to acknowledge my indebtedness to the Editors of the "Saturday Evening Post," the "Metropolitan Magazine," the Star Publishing Company, "Harper's Magazine," "Pearson's Magazine" (London), and the "Daily Mail" (London).

CONTENTS

I. THE TRIUMPH OF THE DOCTOR	I
II. THE REAL PERILS OF WAR	21
III. FEEDING A MILLION MEN	51
IV. THE SUPERB HEALTH OF THE ARMIES . .	83
V. THE LAND OF THE HAPPY WARRIOR AND THE CHEERFUL WOUNDED	95
VI. A DAY IN A FRENCH FIELD HOSPITAL . .	113
VII. THE RISKS OF A RED CROSS NURSE. . .	125
VIII. GAS-GANGRENE AND TETANUS	132
IX. HEALING THE WOUNDS OF WAR, OR THE CARREL TRIUMPH	147
X. THE STRANGLERS	168
XI. THE DRINKING-WATER OF THE SOLDIER . .	197
XII. GUARDING THE HEALTH OF OUR FIRST AMERICAN TROOPS IN FRANCE	209
XIII. NEW FACES FOR OLD AND MAKING A FRAC- TION EQUAL A WHOLE	227
XIV. THE NEW DISEASES OF THE WAR . . .	248
XV. KEEPING THE CAMPS HEALTHY	262
XVI. THE PROBLEM OF TUBERCULOSIS . . .	275
XVII. THE PLAGUES OF ARMIES	293

XVIII. THE EFFECTS OF WAR ON THE CIVIL POPU- LATION	313
XIX. GUARDING THE HEALTH OF THE NAVY	331
XX. SHELL-SHOCK AND THE MENTAL STRAIN OF WAR	358
XXI. THE HEALTH OF THE AVIATOR: SAVING THE BIRD-MAN FROM EXTINCTION	380
XXII. THE UNIVERSITY OF THE ARMY: WAR AS A COLLEGE COURSE	403
XXIII. THE ARMIES AT PLAY	415
XXIV. THE PULSE AND TEMPERATURE OF FRANCE	430
XXV. MOUNTAINS AND MEDICINE: ITALY'S WAR ON DISEASE	444

ILLUSTRATIONS

WAITING FOR THE HOSPITAL TRAIN TO START

Frontispiece ✓

INOCULATION AT SALONICA 12 ✓

A WOUNDED FRENCH SOLDIER RETURNING ON FOOT
TO THE DRESSING-STATION 38 ✓

Photographic Section of the French Army

A GROUP OF LADY AMBULANCE-DRIVERS 44 ✓

QUININE PARADE IN THE SALONICA ARMY 48 ✓

A WOUNDED MAN CHEERED BY A CHAPLAIN AS HE IS
BROUGHT IN ON THE LIGHT RAILWAY, WESTERN
FRONT 96 ✓

WOUNDED ON THE LIGHT RAILWAY, SALONICA FRONT 96

DRESSING A GUARDS OFFICER ON A FLANDERS
BATTLE-FIELD 100 ✓

CANADIAN RED CROSS MEN ATTENDING TO WOUNDED
GERMANS AT AN ADVANCE DRESSING-STATION . 100 ✓

Canadian Official Photograph

IN A FRENCH UNDERGROUND DRESSING-STATION . 104 ✓

French War Office Official Photograph

LADY LORRY-DRIVERS 120 ✓

A CHEERFUL WOUNDED CANADIAN OFFICER BOARD-
ING A HOSPITAL TRAIN 120

Photograph from the Canadian War Records Office

A V.A.D. AT WORK IN FRANCE	126 ✓
SLEDS USED FOR CONVEYING THE WOUNDED THROUGH THE MUD ON THE FRENCH FRONT	142 ✓
ARRIVAL OF WOUNDED AT A FRENCH BASE HOSPITAL	158 ✓
<i>French War Office Official Photograph</i>	
TRANSPORTING WOUNDED TO A FIELD DRESSING- STATION ON THE SALONICA FRONT	174 ✓
BRINGING IN A WOUNDED CANADIAN THROUGH THE MUD ON THE WESTERN FRONT	174 ✓
<i>Photograph from the Canadian War Records Office</i>	
A PATIENT COMING ON BOARD A HOSPITAL BARGE	206 ✓
A FRACTURE CASE IN A HOSPITAL ON THE WESTERN FRONT	238 ✓
A STRETCHER-BEARER PARTY COMING THROUGH THE MUD	266 ✓
A BRITISH TOMMY HELPING A GERMAN PRISONER CARRY A WOUNDED GERMAN THROUGH THE TRENCHES	266 ✓
AMBULANCE AND DISPATCH-RIDER COMING FROM A BATTLE ON THE SALONICA FRONT	298 ✓
CANADIAN WOUNDED GOING TO THE DRESSING-STA- TION ON A LIGHT RAILWAY	314 ✓
<i>Canadian Official Photograph</i>	
STRETCHER-DRILL: TAKING AN "INJURED" MAN BELOW FOR TREATMENT	346 ✓
AN ADVANCE DRESSING-STATION NEAR THE LINE ON THE WESTERN FRONT	380 ✓

ILLUSTRATIONS

xv

INDIAN SOLDIERS CARRYING IN ONE OF THEIR OFFI- CERS	412	✓
SERBIAN WOUNDED COMING FROM THE MOUNTAINS .	446	✓
TRANSPORTATION OF WOUNDED BY TROLLEY IN THE ITALIAN MOUNTAINS	468	✓
<i>From an Italian Photograph</i>		
ITALIAN WAR DOGS	480	✓
<i>Italian Official Photograph</i>		

*Except as otherwise stated the Illustrations are from
British Official Photographs*

THE DOCTOR IN WAR

I

THE TRIUMPH OF THE DOCTOR

SAVING SCIENCE VERSUS DESTRUCTIVE SCIENCE

WAR, like life, is full of contradictions. Aiming solely at the destruction of enemy life by its own legitimate and special weapons, it actually destroys and loses five times as many soldiers by disease as in battle, and while waged solely between armed men, its heaviest slaughter has always been among women and children. When a soldier bravely enlists for the defense of his country, he thinks only of facing the risks of battle and sudden death, but until this war his far greatest risk was that of dying of typhoid or cholera in a summer camp, or pneumonia in a winter one.

The doctor has made this world-struggle probably one of the least deadly ever fought in proportion to the numbers engaged. Less than one twentieth of the wastage of ancient war — that is, three years or more ago — was due to wounds or deaths in battle,

the other ninety-five per cent was caused by disease, epidemics, and pestilences, both in the field and at home. In the armies themselves the ratio was six to nine deaths by disease to one in battle or from wounds. In this war the ratio has been double reversed — sixteen deaths in battle to one from disease.

By wiping out epidemics the doctor has actually kept the death-rate among the civil populations of the Allied countries as low as, and in some cases lower than, it was before the war. By redoubling the care and protection of young children almost as many additional young lives have been saved, as adult ones have been on the field of battle. So that the populations of the Allied countries are practically holding their own.

The doctor's control over wound infections is so masterly that of the wounded who survive six hours ninety per cent recover, of those who reach the field hospitals ninety-five per cent recover, and of those who arrive at the base hospitals ninety-eight per cent get well. The twin angels, anæsthetics and antiseptics, have not only enormously diminished pain and agony, but have made amputations rarer and grave crippling fewer than ever before in war history. Barely two per cent of the wounded are crippled or permanently disabled.

From the statistics made public there is good rea-

son to believe that the death-rate of this war, in spite of the colossal increase in instruments and engines of scientific slaughter, does not much exceed three per cent per annum. The same ingenuity that sharpened the attack has strengthened the defense. The spade is mightier than the shrapnel, the scalpel than the sword, the test tube than the trench mortar. Chlorine saves more lives, as Dakin's fluid in wounds and bleaching powder in drinking-water, than it destroys as poison gas.

An army camp used to be a hotbed of epidemics, a breeding-place of pestilences. The soldier's worst enemy enlists with him, for what killed most men in war was not bullets, but "bugs," not the sword but the streptococcus. Whenever you mobilize and call to the colors a thousand men, you call with them at least twenty billion tubercle bacilli, ten billion typhoid, five billion pneumonia, and a couple of million dysentery germs. An army assembles literally primed and loaded for trouble — from the inside.

The first thing an army in the field does is to foul its own water-supply and the second is to infect its food by the swarms of flies bred in its garbage dumps and manure heaps.

In the old days armies simply rotted with disease in their winter quarters; forces which had gone into winter camp in good health and spirits were often so reduced in the spring as to be actually unable to

take the field. Gustavus Adolphus once broke camp and started on his spring campaign two months earlier than he had intended simply for fear he would not have any army left to campaign with if he waited till summer.

The armies in Flanders and northern France last winter, out in open trenches in some of the vilest and "sickliest" weather troops ever had to face, had less sickness and fewer deaths from pneumonia and all other diseases than they used to have in barracks in time of peace and far less than the general civil population at home.

Inoculation protected them against typhoid; splendid feeding, with plenty of meat and fat, against pneumonia and consumption; fly campaigns against dysentery and diarrhoea; shower baths and clean underwear against spotted typhus; and quarantine against all the mild, infectious measles, summer diarrhoea, diphtheria, and influenza.

The old plagues of army camps, cholera, Black Death, and spotted typhus, all lifted their heads and began to "resurrect," in Italy, in Serbia, and in Russia, but all were promptly stamped out by modern sanitary science — cholera by isolation, disinfection, and the vaccine, Black Death by exterminating fleas, typhus by "unlousing" and hot shower baths. "There is no armor against Fate," but when it comes to typhus a clean undershirt pretty well fills

the bill and is a better life protector than any shirt of mail.

Only three new inventions in the disease line have appeared in this war: trench fever, trench nephritis, and trench feet. The last two are still a puzzle as to causation, but all three have been brought down to comparatively slight proportions and importance, by good sanitation, properly drained trenches, loose, comfortable foot- and leg-wear, regular washing and greasing of the feet every night, clean socks and plenty of them. Trench fever has been proved to be carried by the bite of the louse or "cootie."

The mental damage inflicted upon the soldier by the horrors and strains of this war has been astonishingly small. The total number of cases of serious or lasting "shell shock," so called, and mental disturbance in the British Army in France during 1916 was twenty-six hundred, less than one per thousand of the armies in the field and *little more than the ordinary insanity rate in men of military ages in times of peace.*

Modern nerves have stood the fearful strain of this war superbly, and the more "modern" and citified they are the better they stand it. Men of every race, color, and grade of civilization have been tested in this war, and while all were brave and devoted and with the highest respect for the noble and loyal service rendered by tropical and Oriental troops, none

have borne the ghastly horrors of shell and mine and poison gas so well as the highly civilized white races. And without invidious distinction, among the steadiest, stanchest, and most "shell-proof" of all stands the highly citified and alleged "neurotic" Cockney.

As for the ancient and classic plague of armies, venereal disease, in spite of the special temptations to which soldiers in the field are exposed, away from home associations and ties, — any pleasure may be their last, etc., — and in spite of the disgraceful solicitations to which a silly sentimentalism and ostrich-like Puritanism permit them to be subjected in London on leave, here are the figures: —

	Venereal disease
British Army in time of peace (1905).....	12 per 100
" " " " " " (1913).....	6 " "
" " at home (1916).....	3 " "
" " in France (1916).....	2.4 " "

In other words, the average incidence of venereal disease in the British Army in France is no higher than that believed to exist among men of military age in time of peace; while in the American army in France, by cutting out sentiment and treating venereal disease like any other contagious disease, it has been brought down to *less than one per cent.*

If we would stop preaching and exhorting about venereal disease as a moral problem and treat it strictly as a sanitary one, for the duration of the war,

we could soon bring it well below its former prevalence in times of peace. Especially if, in addition, we would frankly recognize the prostitute for what she really is — a helpless feeble-wit, selling her body because she has no brains to sell — and take charge of her as a permanent ward of the State in beautiful, comfortable cottage colonies out in the open country.

If the soldier on leave were systematically provided with easy, abundant opportunities to meet and dance and go sight-seeing with nice girls and women he would never miss the bad ones, for the minds of young men are cleaner than those of most of the middle-aged who exhort them.

At first sight it would appear as if the doctor could do little to limit the deadliness and slaughter of war. He could bind up wounds and ease pain and nurse the sick, but what could he do to stop bullets from finding their billet or shells from bursting in crowded trenches? But this idea, plausible as it sounds, is due solely to the fact that, until recent years, no one realized, or even knew, what an enormously large part disease has played in the death-rate of an army.

Just as an illustration of the real deadliness and true perils of former wars may be cited the famous Thirty Years' War. It is estimated that during this fierce and bloody strife, which ranged from the Mediterranean to the Baltic for a full generation, the pop-

ulation of Central Europe was reduced from nearly thirty million to less than thirteen million. Yet in the whole of this time only about fifty important battles were fought, whose total losses in killed and wounded amounted to less than half a million men.

All the other fifteen million died of disease and famine and pestilence. The population of one city, for instance, Oldenburg, shrank from nearly four hundred thousand to less than seventy thousand, and it had never been besieged nor had any battles been fought in its near neighborhood.

When Napoleon, having conquered Europe, turned his ambition and attention to America, it was pestilence and not powder and ball which barred his way and sent him down to utter defeat. He landed an army of fifteen thousand men, splendidly equipped, on San Domingo; they were to seize the island, build camps, and prepare a base from which the real army, which was to follow them, could conduct operations against Mexico and New Orleans. But the fierce guardian angels of the tropics, yellow fever and malaria, fell upon them, and before the main army could start, there were barely three thousand of them left alive, and the project was abandoned in dismay. Six months later a couple of French ships from Martinique came and carried off the few hundred wretched survivors.

On the other side of the Napoleonic struggle,

Wellington's army in the Peninsula lost ten times as many men from disease as from battle, and more in one winter's encampment without any fighting than in the whole previous summer's campaign, and this represents about the general ratio between diseases and battle casualties during the last century.

Contrary to immortal popular tradition, which is usually wrong, Napoleon's ghastly defeat in his final Russian campaign was due neither to the wasting of the country with fire and sword by the Russians as they retreated — for the Great Commander never for a moment attempted to live off the country in any of his campaigns, and insisted upon his armies being as well supplied with food as they were with ammunition — nor yet by “General January and General February.” For in spite of all the snow-scene pictures which have been painted of the great retreat, remnants of his army came back across the Beresina *early in November*, before the winter had set in. The real enemy that mowed down his magnificent army, well-fed, well-clothed, superbly equipped as it was, was spotted typhus, due to lice, which raged through its ranks like a forest fire.

By the middle of the last century the death-rate from disease in war had fallen somewhat, and in the American Civil War the ratio was about five deaths from disease to one in battle. Almost the same ratio was maintained in the Spanish-American War and

the Boer War in spite of sanitary improvements, and the first clean reduction was made in the Russo-Japanese War on the Japanese side. It was here for the first time in history that the doctor was given real power and authority in an army and the control of its sanitary conditions. This brilliant new nation was just innocent enough actually to put into practice the sanitary principles which all the European armies had simply talked about, but never dreamed of putting into force, with the result that the death-rate from disease fell to less than half its former amount—that is, to about two and one half times as great as the battle- and wound-rate.

This was the record performance when the present war broke out, but we have beaten it “out of sight,” as the Westerners say, already. The example of Japan has not been wasted; the army doctor has been taken seriously from the start, and the sanitarian has been given a chance to make good his claims of prevention, with the cheering and almost incredible result that the ratio of deaths from disease to those from bullets has been something like double reversed, from five to one, to more than ten to one in the opposite direction. That is to say, that instead of five men dying of disease to every one in battle, in the British army on the Western front, only one life has been lost by disease to every ten in battle. In fact, disease as a factor in the army

death-rate has been almost wiped out, completely so in the sense that the amount of sickness in the camp and the deaths from disease at the front have been barely half what they were in barracks in times of peace.

This magnificent result, which amounts to the saving of at least four hundred thousand lives a year on the British Western front alone, has been brought about chiefly in three ways, protection of the troops against infectious disease by the anti-typhoid inoculations and other sanitary measures, by surgical skill and superb hospital organization enormously increasing the recovery rate from wounds, and by the splendid way in which the armies have been fed.

The greatest single sanitary triumph of the war has been the wiping out of typhoid fever by means of inoculation or vaccination. This is the real plague of armies in the temperate zone, as may be illustrated by the fact that it caused twice as many deaths in our American Civil War as battle wounds did, five times as many in the Spanish-American War, and nearly twice as many in the Boer War. According to its former prevalence we should have had three hundred thousand cases a year on the British Western front alone, while as a matter of fact we have had only two thousand cases all told during three years among nearly three million men.

That this astounding, almost incredible reduction has been due to inoculation has been proved, first,

by the experience of our American army, which has scarcely had a death from typhoid in the six years since anti-typhoid vaccination was made compulsory and complete; second, by the fact that both the French, and, I am happy to say, the German armies suffered heavily from typhoid during the first year of the war, less than ten per cent of them being protected by vaccination — as soon as they set about full and complete vaccination of their forces, within six months typhoid was almost at its vanishing point, without any further improvement of the sanitary conditions of either army; third, by the fact that the typhoid rate among the small uninoculated minority of the English troops is ten times as great as that among the millions of inoculated, and the death-rate nearly forty times as great.

After typhoid the two next deadliest and most serious camp diseases, diarrhoea and dysentery, have been kept under by scrupulous watchfulness over the water-supply, which in many areas has been brought in pipes, from streams or reservoirs many miles distant, or filtered in sand-beds, or, where this was impossible, disinfected by treating with chlorine, in the form of bleaching-powder. This last, if not very carefully done, sometimes leaves a disagreeable chemical taste in the water, at which the soldiers grumble a good deal, especially as it spoils the taste of their tea, a most vital and sensitive point.



INOCULATION AT SALONICA

But in spite of occasional unpleasantness, the bleaching-powder in the water is a wonderful protection and safeguard, as in quite moderate amounts it will destroy all germs of infection that may have got into the water, — diarrhœa, dysentery, typhoid, and cholera, — while at the same time it is harmless to the human stomach, and if given sufficient time to neutralize and settle it leaves no unpleasant taste behind it.

But the chief weapon against diarrhœa and dysentery is relentless warfare against that unsufferable little pest and carrier of pestilences, the fly. His "beat" is of the simplest: he visits the latrines and loads up with the germs of dysentery, diarrhœa, or typhoid, flies to the tents and mess kitchens and distributes them broadcast over the food, both on the table and in the larders and kitchens, if left un-screened.

In this war no mercy has been shown him; he has been cut off from his supplies of infections by burning in incinerators all human excreta and other camp wastes. He has been shut out of the dining-rooms and kitchens by screens or windows. He has been trapped in a thousand ingenious ways, from sticky strings and strips and papers to big box-traps.

Last, and deadliest of all, he has been deprived of any possible place to lay eggs and breed by burning or carting out on to the land all manure heaps, garbage dumps, and dirt piles.

So successful has this warfare been that many of our army camps by constant vigilance have become almost "flyless towns" and some of the most complete triumphs of this sort have been won on the Italian front with its sub-tropical climate.

The second great victory over the death-rate of the war has been the wonderful skill and care of our doctors and nurses in the treatment and handling of wounds. In spite of the fact that the wounds in this war, being eighty to ninety per cent from shell fragments, have been the ghastliest, the most horribly lacerated, and the most vilely infected ever known, so that we had to go back to the beginning and start over again, the team-work between surgeon, ambulance, and nurse has been so superb that of the wounded who live long enough to be carried down to the ambulance, ninety per cent recover, of those who survive to reach the Casualty Clearing Station, ninety-five per cent recover; and of those who reach the Base Hospital, ninety-eight per cent recover.

There are hospitals in England which have handled six, eight, ten thousand successive cases with only about three or four deaths in the thousand. Never was such a recovery-rate known in the world before. In the olden days fifty per cent was considered an excellent recovery-rate, while as recently as the American Civil War, the death-rate among the wounded was at least twenty per cent, and

often, when hospital gangrene broke out, rose to forty and even sixty per cent. When it is further stated that of all the wounded eighty per cent are able to return to the front within a little over forty days, it will be seen what a powerful and immensely important factor in keeping up the strength of the army the doctor is to-day. Even the haughtiest line officer must admit that he is entitled to some authority and a voice in the direction of army affairs.

This wonderful result and triumph of surgery has been brought about in face of the greatest difficulties from the beginning. For twenty years past the wounds of modern war have been becoming less deadly, because less infected. So tremendous is the pressure and friction upon the high-velocity bullet as it is driven through the barrel of the modern rifle, that it is practically sterilized by heat and enters the body of its victim germ-free. Furthermore, by its whirling motion and pointed tip it makes a very small wound with an almost "seared" track, which is followed by very little hemorrhage unless it has struck a large artery.

I have seen bullet wounds on the Western front in this war which had gone completely through an arm or a leg without hitting the bone, and were practically healed, with only a round dry scab at each end to show for them, inside of eight or ten days.

But, alas, bullet wounds have played an aston-

ishingly small part of the casualties of this war; from the beginning eighty-five per cent of all the wounds were from shell fragments, and this has since risen to ninety and ninety-five per cent. And a shell wound is everything that a wound should not be — huge, ragged, irregular, like the jagged and saw-tooth-edged fragments which produce it, and worst of all horribly infected. This is due to the fact that most shells not only strike the ground, but bury themselves somewhat before they explode, and hence every sharp-edged fragment comes up simply loaded with dirt and swarming with all the germs and filth that may be in the soil.

As the fighting in Belgium and northern France has been over the most intensively cultivated and richly fertilized soil in Europe, all the germs which exist in stable manure and fertilizers of all sorts have been hurled into the utmost depths and remotest corners of every wound. Unfortunately two of the deadliest germs known to surgery, the tetanus bacillus and the bacillus of gas gangrene, have their normal habitat in the intestines of the horse; therefore there was a terrific outbreak of both tetanus and gas gangrene in the very first months of the war.

The tetanus or lockjaw was quickly brought down by the use of the tetanus anti-toxin, and the gas gangrene was successfully attacked by new methods of operations and irrigating the wounds; but both

dangers still hang over us and can be avoided only by sleepless vigilance.

Another service of great value to the war strength of the nation has been rendered by the doctor and the sanitarian which, although less dramatic and attracting less attention than that accomplished upon the field of battle, is almost equal to it in importance. This is the persistent, tireless, successful war waged by our medical officers of health, our medical inspectors of factories and industries, and the various organizations for fighting tuberculosis and lowering the child death-rate. We have become, perhaps, accustomed to look upon this sort of vigilance as a matter of course and even inclined to be a little skeptical as to the reality of the dangers which we have avoided through its exercise.

But the strain and stress of war have both increased its powers and brought its results into high relief, in the gratifying and encouraging fact that in spite of the absence of wage-earners, in spite of the anxiety and grief and hardship inseparably connected with war, in spite of the scarcity of some and the high prices of all classes of food, the English civilian death-rate and disease-rate have not only not increased during the war, but have actually been decreased and brought down to the lowest figure in history.

Such excellent and watchful care has been taken

of the feeding, the hours of work, and the conditions of labor of the workers, such special efforts have been put forth to safeguard the lives and improve the food and health surroundings of young children, that there is good ground for the statement that England is actually saving life at home faster than it is being wasted upon the field of battle abroad. So that the population of Great Britain is not only not diminishing, but actually slightly increasing in spite of the war. In fact, incredible as it may sound, the total death-rate, both military and civil during the last three years, is very little higher than what would have been considered an average one in the civilized countries of Europe sixty or seventy years ago.*

This successful fight against disease and death at home has been greatly helped by one of the curious compensations of this war, and that is the extent to which it is a war of huge cannon and high explosives, of engines of destruction, and of machinery in every imaginable form. This means an immense demand for factory production of every sort at home, with wages to match; indeed, as Mr. Lloyd George has stated in one of his speeches, it takes four men and three women in factories and on the railroads at home to support and supply one fighting man on the line of battle.

This means that the wealth of the country has been distributed and is being distributed increas-

ingly among those who need and deserve it most, that the women and children and men unfit for military service at home, instead of being left unemployed and starving, have had abundance of work at the highest wages ever known. Although food is high, wages are still higher and the net result of it all is that never were the great eighty-five per cent mass of the people, the laboring classes, so well fed, so well clothed, so well housed and sanitated, and in such excellent physical condition as they are to-day.

What is almost more gratifying, the ruthless pressure and emergencies of war have revealed the fact, which we doctors have been preaching for years, that the better the workers are fed and housed, the shorter, within reasonable limits, their hours of employment, the higher their wages, and the more ideal the sanitary conditions under which they work, the more and better work they will do, and the larger profits they will earn for their employers. In fact, the interests of employers and employed are not different and hostile, but one and identical, and the demonstration of this fact has brought a new spirit of friendliness and mutual interest and regard for each other's welfare into the industrial world, which will never die out, but will survive long after the war is over and half forgotten.

One of the most cheering and encouraging aspects of a visit to the front and the actual fighting line

is the sense of a whole-souled devotion to a common end and of a real community of interest and brotherhood of helpfulness, among tens and hundreds of thousands of men. It is a real Utopia, a genuine democracy, with every effort devoted to a common end and the common welfare. If this spirit, returning from abroad, shall fuse with the new spirit at home, as it certainly will, the world will be lifted to a higher plane of fairness, of kindliness, and of justice, and even the bitter and pitiful losses of this deplorable war may prove to have won an adequate reward.

II

THE REAL PERILS OF WAR

FROM the earliest dawn of consciousness the three most dreaded perils of the race have ever been war, pestilence, and famine. And the greatest of these is war. Every age has echoed the sobbing chant of the Litany: "From battle and murder, and from sudden death, Good Lord, deliver us."

The march of civilization has been one long, bitter fight against this devil's trinity, and up to about a century ago with indifferent success. Then the harnessing of steam and the birth of science began to make man the master of the elements and the gods, instead of their football; and within fifty years more headway was made against these three Furies than in fifty centuries before. During the next half-century — the past fifty years — this has been simply multiplied by five.

Famine was the first of the hereditary curses to go down and be swept off the earth. This does not sound remarkable to us now, because we have forgotten that bitter starvation and death by hunger were once parts of the regular process of the seasons. Famine occurred every winter among savages, every three to five years among semi-civilized peoples, and,

on an average, about every fifteen years among the most highly civilized nations, until about seventy-five years ago.

It was the deliberate and carefully considered statement of one of the greatest English economists, sixty years ago, that four fifths of the people of Great Britain never in all their lives had had as much as they could eat, and never were comfortably warm from November to April. Now famine — thanks to our steam-won conquest of empires of virgin soil — is a thing unheard of and incredible among civilized races. The last flickering horror of it in western Europe was the year of the potato blight in Ireland, and, in eastern Europe, the year of the corn mildew in Russia; though like the rest of the dead and half-forgotten plagues of the past, famine has again “resurrected” to play a part in this war and has actually claimed more people in Poland, Russia, Armenia, and Serbia than the sword or the shell.

The next to weaken and give ground was the plague of the pestilence. That winning campaign is such recent history as to be within the memory of all; indeed, many of us have borne or are still bearing a musket in the ranks. The victory is more than half-won already; and the end — the sweeping away of all infectious disease and the bringing of two thirds of all deaths under two great causes, accident and old age — is in sight.

What have we accomplished against the last great enemy of humanity — war? From some points of view, painfully little. If we look at the so-called leaders of civilization piling up armament on armament; loading war taxes on the backs of the peasant and the laborer until they groan beneath the burden; matching regiment against regiment and dreadnought against dreadnought in insane rivalry, which has finally burst the bounds of civilization and is deluging Europe with blood, we are ready to cry in despair that our boasted progress has been but milling in a circle, and to echo Browning's despairing apostrophe to the Prince of Peace: —

"Whose sad face on the cross sees only this,
After the passion of a thousand years."

Plunged at a moment's warning, by the mad vanity and insensate jealousy of a few hereditary leaders, into what bids fair to be the bloodiest war of all history, it hardly looks as though we could boast ourselves of any real superiority over the Huron-Iroquois Confederacy or the age of Attila and Jenghiz Khan.

When we come to look at the actual facts and conditions of war, however, the manner in which it is waged and the circumstances under which its grim purposes are carried out, we find considerable ground for encouragement. War, of course, is, and in the nature of it always will be, exactly what General

Sherman called it; but even the cheerful pastime of slaughtering our fellow men has in the most recent wars been carried on with smaller loss of life and less suffering and hardship, both to the actual combatants and to the non-combatants in whose territories the war has been waged.

It has taken a smaller percentage of dead and wounded to decide the fate of a battle. The actual losses in battle have grown steadily less in each successive century, and the total death-rate of the most recent wars has been barely a fifth of what it was a century ago. The average death-rate of the first three great wars of the past century — the Napoleonic, the Mexican, and the Crimean — was 12.5 per cent a year; that of the last three wars — the Spanish-American, the Boer, and the Russo-Japanese — was 4.8 per cent; that of the present so far is about 3 per cent.

How has this unexpected change and remarkable improvement been brought about? At first sight the fact itself will probably be called sharply in question and seem almost incredible. The burden of the song of the modern advocates of peace is that owing to the fiendishly ingenious improvements which have been made by science in our implements of slaughter — dynamite shells, rifles that kill at ten times the old range, cannon that hurl a ton at a shot, Maxims and Nordenfelts that pour bullets like a

stream from a fire hose — war has become so horribly deadly, so cataclysmic in its destructiveness, that human spirit and flesh and blood can no longer endure it.

Here we go at it since 1914, however, as coolly and recklessly, though not quite so cheerfully and light-heartedly, as they did in 1419. The reason is that the same brain which invented these killing-machines has to some extent devised means for neutralizing or evading their deadly effects. A battle may be fought to-day with high-velocity bullets, the latest field artillery, lyddite or cordite shells, dynamite mines, and pom-pom machine guns capable of mowing their way through the trunk of a tree, and decided with less than half the loss of life that it cost in the days of the arrow, the javelin, and the spear, or in those of the flintlock and the sabre.

That this striking decrease in the fatality of war has actually occurred is as abundantly attested as any fact of history; for, since the time when anything approaching accurate records have been kept of battle losses, each century has shown a steady and constant lowering of the number killed and wounded in proportion to the forces engaged. But the history of the battles now being fought has still to be written.

In the days of Agincourt, for instance, when the issue was decided by showers of arrows at fifty paces, or by sword, spear, and battle-axe, breast to breast

and hand to hand, the average loss in killed and wounded was anywhere from fifteen to thirty per cent of the forces engaged; in fact, in those days the soldier who came out of a seriously disputed battle between anything like equal forces without some kind of wound was looked on with considerable suspicion as to his courage or his fidelity.

After the introduction of gunpowder, — which, paradoxical as it may seem, has been one of the great life-saving forces of history; first, by deciding battles at long range; second, by breaking up and wiping out of existence the baron's castle and the walled and fortified town; and third, by making civilization permanent, eternally superior to savage attack, Goth, Vandal, or Hun, — though much larger armies were brought into the field and campaigns conducted on a far more extensive scale, the actual percentage of losses fell distinctly.

By the time the Napoleonic wars were reached the death-rate in war from all causes had fallen to about one hundred and twenty-five per thousand a year, or about twelve per cent. In our own Civil War it fell to ten per cent. The Sedan campaign cost the German army only eight per cent of its three quarters of a million men; while our Spanish-American War and England's Boer War reached the low-water mark, with barely three and four per cent of loss respectively.

As to the cause of this gratifying reduction in war fatalities, several influences have been at work. One of the most obvious has been that the invention of gunpowder and the improvement of rifles and artillery, with such enormous increase in their range of death-dealing, has steadily forced more and more of the fighting to be carried on at long range.

The net result of this has been that not nearly so many men are actually hit as in the days of old point-blank firing by platoons; that as a battle becomes a long-range duel, directed by field-glasses, heliographs, and telephones, its fate is decided more and more by maneuvers such as surrounding a force or cutting it off from its base than by actual sacrifice of life or by weight of numbers in a bayonet charge. That both these influences are at work and have operated in this direction is unanimously admitted by all military experts and supported by convincing proof.

In the first place, the weight in lead or shells which has to be fired from rifles or cannon in order to kill a single soldier has markedly increased within the last fifty years. The old saying used to be that every bullet had its billet. Then, twenty or thirty years ago, this was changed to the statement that for every man killed his own weight of lead or iron in the shape of bullets or shells had been fired. In the last official slaughter but one — the Balkan War — a Belgian

surgeon, Dr. Laurent, who served with the Bulgarian army, calculated the actual expenditure of ammunition compared with the number of Turks killed, and found that there were one hundred and ten rifle balls and ninety shells and shrapnel fired for each dead Moslem. While in this present war it is estimated to take nearly two tons of shells and explosives to kill one enemy soldier.

The other most important change, due to the new methods of fighting since the use of gunpowder and long-range weapons, was that in the old days, when battles were decided by hand-to-hand fighting, the victors were literally right on top of the vanquished the moment the tide turned and the retreat began; and only superior fleetness of foot or length of wind could save a very large percentage of the beaten troops from slaughter, maiming, or slavery.

By far the most important and influential factor, however, in denaturing and taking the curse off war has been the advance in medical science. This may seem, at first sight, an extraordinary, if not extravagant, statement; for even the most enthusiastic champion of medicine will admit that, with all our progress, we have never been able to raise the dead, or do much to restore the man who has had his head taken off by a cannon ball or been blown to pieces by a shell. Doctors may cure diseases, but they cannot do much to remedy sudden death.

This incredulity, however, is simply due to a misunderstanding of the facts. Naturally enough, since the main business of war is the slaughtering or disabling of the enemy, we have taken it for granted that the chief risk of warfare is that of death in battle. As a matter of fact, battle is one of the least of the perils of war; for until within the last forty or fifty years the loss in battle and by wounds has never been more than a fifth as great as the loss resulting from disease. In Napoleon's Peninsular campaigns, for instance, of four hundred and sixty thousand men lost, only sixty thousand fell in battle — that is to say, in bloody war disease caused from five to twenty-five times as many deaths as the sword or the bullet. And the real horror of war is fever. The whimsical paradox holds that, by cold figures, soldiers are safer on the battle-field than in camp, though not in proportion to the time spent there.

Four fifths of the slaughter in war has in the past been due to disease, and at least ninety per cent of that disease is preventable; in fact, it has already been prevented in one epoch-making modern instance — among the Japanese in the Russo-Japanese War, where the death-rate from disease was barely two per cent. Improvements and progress since then have put us in a position to cut in two even that low rate and reduce it to one per cent a year, or the same as that of a similar body of men engaged in peaceful occupations.

Even the direct and necessary fatality from deaths in battle and from wounds has been tremendously reduced by medical science. Though those who are killed outright, or are so terribly torn and mangled that they die from shock or hemorrhage within a few hours, are, alas! beyond our skill, these constitute barely half of the total deaths from battle; in fact, when we first begin to study the figures we get the gruesome impression that war is becoming deadlier, because a so much larger percentage of the lost are killed outright or die on the field.

In an earlier day the proportion used to run: five thousand killed in battle; seven, ten, or twelve thousand died of wounds. About fifty years ago the proportions became about even. In our Civil War the deaths on the battle-fields forged ahead — namely, sixty-seven thousand, while only forty-three thousand died of wounds. In the Franco-Prussian War, on the German side seventeen thousand were killed outright and eleven thousand died of wounds; while in the Russo-Japanese War forty-seven thousand Japanese fell in battle and only eleven thousand died of wounds, making the proportions over four to one. In the first Balkan War the figures ran thirty thousand to twelve thousand.

The briefest hospital experience will explain this paradox. There are as many wounded in proportion to the killed outright as before; only, instead of from

twenty to fifty per cent of the wounded dying from their wounds, as in the old days of hospital gangrene, tetanus, and erysipelas, in these days of antiseptic surgery, from ninety to ninety-five per cent of the wounded recover.

To put it briefly, judging from the statistics of recent warfare the chances of the modern soldier's being killed in battle in a year's campaign have been reduced to about one in thirty; his chances of dying of wounds received in battle to about one in sixty; his chances of dying of disease to less than one in a hundred. How this compares with an earlier day may be illustrated by one concrete average instance: In the Russo-Turkish War of 1828, out of an army of one hundred and fifteen thousand Russians who crossed the border, not more than fifteen thousand ever returned to Russia, after serving in only two campaigns.

One of the interesting by-products, as the chemists say, of this transformation of warfare is the striking diminution in suffering, agony, and discomfort of those who actually become food for powder.

It is, of course, obvious that those who are killed instantly on the field of battle mercifully suffer no pain; and consequently the larger the percentage of such deaths in the total number of fatalities the less the actual agony and suffering endured. The old prayer to be delivered from sudden death had it

wrong. It is from every point of view the best form of death there is — though we are not anxious to have Gabriel call us any earlier than necessary.

In the second place, the greater part of the pain and suffering and agony produced by wounds comes not at the time of their infliction, or within six or eight hours thereafter, but when they begin to fester and suppurate and inflame. This we used to call, in our innocence, the process of healing; now we know it to be the onset of infection.

It is difficult to make any one who has not had actual experience, either as a surgeon or as a patient, believe it; but it is, nevertheless, a merciful fact that the severest and most serious injuries or wounds often cause astonishingly little pain at the time of their infliction. A broken leg or a broken arm, for instance, eight times out of ten causes little or no pain. Thousands of cases are on record where a man has had his leg broken in a railroad wreck, or runaway accident, or factory smash, and has never known that it was broken until he tried to move it or to walk on it. The same is true of bullet wounds. Many a soldier in a bayonet charge has suddenly plunged headlong, feeling as though one leg had gone numb, or supposing he had tripped or stumbled; and when he tried to rise has found the bone shattered by a bullet.

On the other hand, many wounds, not at all dan-

gerous to life or even temporarily disabling, are agonizingly painful simply because the injury has been just severe enough to tear or graze or lacerate the nerves, but not sufficiently crushing or stunning to numb and paralyze them. This is not, by any means, to say that to be wounded in battle is a trifling and painless amusement; but only that a considerable percentage — from fifty to seventy would not be too large an estimate — of the more serious wounds, and a still higher percentage of the mortal ones, are attended with comparatively little serious or agonizing pain.

In war, as in the sick-room, the ability to feel acute pain is a sign of life and resisting power; and so long as our patients are actually afraid they are going to die, or are making audible complaint of their sufferings, we seldom feel uneasy about the outcome. It is when they begin to lose interest in whether they are going to get better or not, or lie wide-eyed, without uttering a word or making a sound, that we feel the situation is serious. Either disease or wounds that are serious enough to prove fatal or to put life seriously in peril carry, for the most part, — most mercifully, — their own anæsthetics with them, by either crushing or poisoning the nerve-trunks until they are unable to report pain.

Should a bullet or bayonet wound prove fatal, the nerves never recover consciousness, so to speak; but

in those of lighter character, from which the patient is able to rally as soon as strength and consciousness begin to return, the nerve-trunks wake up with the rest of the body, and a period of intense boring or burning pain follows. This, however, can usually be kept fairly within bounds by an opiate and in any severity lasts only until the tissues begin to heal — that is to say, anywhere from six to forty-eight hours.

The time when wounds really begin to hurt is from thirty-six to seventy-two hours after their infliction, when suppuration or inflammation sets in. This swelling and burning and throbbing with a profuse outpouring of matter or pus — *pus laudabile*, “praiseworthy matter,” as it was called — used to be regarded as part of the regular process of healing; but since the days of Lister we have discovered that, instead of being a part of healing, it is a purely mischievous and injurious process due solely to infection with one or the other of the so-called pyogenic or septic germs, usually streptococci or staphylococci. Keep these out of the wound, and inflammation, with its throbbing agony and fever and horrible discharges, will be entirely avoided.

Easily two thirds of the pain and suffering endured by the wounded in war is not due to the wounds themselves or to the process of healing, but to suppuration and infection; and all this has been wiped

out by antiseptic surgery. What military hospitals were like in the pre-antiseptic days begged description, and can hardly be imagined even, let alone believed, at the present day.

Marlborough's surgeon in the famous Blenheim campaign declared that hospitals were the most important cause of death. And a famous French surgeon in 1741 declared that he had known vastly more men to die in the hospitals from lack of care than to lose their lives in combat; and that "hospitals are an unfathomable gulf; the source of their horrors appears to be inexhaustible." Two patients in each bed was the rule and often three or even four. The hospitals were literally breeding-places for disease. The deadly typhus fever used to be known as "hospital fever"; while typhoid, dysentery, erysipelas, and gangrene fairly ran riot in them. Browning's characterization of the mediæval hospital, as "that good house that helps the poor to die," was painfully accurate.

Even as late as our Civil War, when the dreaded hospital gangrene once put in an appearance in a ward it was a sentence of death to be sent into that ward with an open wound; and in some instances from forty to sixty per cent of all the inmates actually died. Up to, and, indeed, during, the Napoleonic wars anywhere from twenty to sixty per cent of the wounded died. To-day any army medical service

that loses more than five or six per cent of its wounded considers itself disgraced.

The methods by which these wonderful savings of life and suffering have been accomplished, the triumphs of antiseptic surgery, need no description; for they are common knowledge, as well as one of the wonders of the age. The strictest and most scrupulous cleanliness, the boiling of instruments, and cleaning of surgeons' and nurses' hands — these are practiced in every hospital and taught to the rising generation in our schools.

The importance of one point, however, is not yet fully recognized, and that is the part played by the individual soldier himself. To see that the instruments and the dressings, the operating-room and the hands of the surgeon are surgically clean will cut off three fourths of the risks of infection; but there is a very important zone of danger, amounting to quite twenty-five or thirty per cent, which has to be crossed before the surgeon ever sees the wound; and that is the first-aid dressings and their use by the soldier himself or his comrades.

You cannot always choose a nice, clean, antiseptic place for a battle; and we now know that the bacteria of the soil, particularly if the soil be cultivated and fertilized with various decaying vegetable and animal substances, may set up serious trouble if they get into wounds. Not only so, but there are

also bacilli that make themselves more or less at home on the surface of the human skin and in the pouches of the hair follicles which, if they get into an open wound, may set up suppuration. It is, therefore, a matter of first importance that a soldier in the field should keep himself and his clothing — particularly his underwear — in as clean, thoroughly washed, and well-ventilated condition as possible.

It is particularly desirable before going into battle to put on a suit of clean underwear, so that if any strands or threads of clothing are carried into a wound by a bullet they will not carry germs with them. One of the reasons why the sea-fighters of Nelson's day used to strip themselves naked to the waist when they served the guns was that they had discovered by painful experience that a splinter or shot which carried with it into the wound a fragment of dirty and sweat-soaked clothing added hugely to the risk of painful and dangerous suppuration.

In all modern armies now the soldier is provided with one or, in some cases, two packages of first-aid dressings. These are wrapped up in oiled paper or oiled cloth, so as to be protected from moisture, dirt, or the penetration of perspiration if carried in pockets or knapsacks. The moment a wound is received the sufferer, or one of his comrades, cuts away the clothing, tears open the package of dressing, applies the pad of cotton or gauze to the wound, and

binds it on firmly with the bandage. Unless an artery of considerable size has been injured the pressure from the dressing soon arrests the hemorrhage, and the blood clots and dries all over the surface of the wound and round the edges, so that rifle wounds are perfectly sealed against all dirt from the soil or from the hands of the sufferer or from air and dust.

The success of this immediate-dressing method is assisted by the character of the wounds made by the high-velocity bullets. These whirl through the tissues at such a tremendous rate of speed that they pulverize and almost cauterize the edges of the wound, so that the bleeding from it, unless a large artery be actually torn across, is often astonishingly slight.

Another advantage of the modern high-velocity bullets is that the wounds they make are almost absolutely sterile. The reason for this is that the tremendous force and speed with which they are driven through the grooves of the rifle barrel raise them to such a heat by friction that any accidental germs that might have become attached to them as a result of their being dropped on the ground, or carried in dirty pockets, or handled with infected fingers, are either scraped off or destroyed; in fact, most fortunately, the modern bullet, like the flatiron Bert Williams left home just six inches in front of, has "nuffin whatever attached to it — but speed!"



A WOUNDED FRENCH SOLDIER RETURNING ON FOOT TO THE
DRESSING-STATION

On the whole, though this was by no means the intention of their inventors, the new high-velocity bullets are more humane and less pain-producing than the old-fashioned round ball or soft bullet. The latter, if it happened to strike a bone, would sometimes spread in the most horrible fashion and tear through the tissues as though a crowbar had been driven through them.

The infamous dumdum bullet, in fact, is a hard metal bullet with a soft perforated lead tip or nose, intended to mushroom in this ghastly fashion whenever it strikes a bone. The new high-speed bullets, on the contrary, drill their way through the soft tissues almost as cleanly as a red-hot bradawl.

Early in the war, in Belgium, one of the German prisoners presented an arm to be dressed which he thought had been slightly grazed, but which on examination proved to have been drilled completely through by a bullet. It had fortunately missed the bone and arteries, and so produced no hemorrhage whatever, leaving only a little, clean-cut, black-and-blue-edged hole in the skin on the front and on the back of the arm, where it went in and came out again.

The behavior of these high-speed bullets when striking bones, however, is very uncertain. In not a few cases they will drill right through an arm or leg bone without even cracking it, making as clean-cut a hole as a drill or a trephine. In other cases, how-

ever, particularly in wounds of the skull, they will shatter the bone for five or six inches in every direction, as a window pane is shattered by a stone, and do exceedingly serious damage. They may also strike some obstacle, or ricochet from the ground, bend into a crescent and strike sidewise, with ghastly smashings and tearings.

On the whole, however, when these bullets kill, they kill suddenly and painlessly. The wounds are followed by little hemorrhage and by less pain than those inflicted by the old-fashioned bullets; the risk of suppuration is less; and they heal in from one half to two thirds of the time required by other wounds. Oddly enough, they have one peculiar disadvantage — from the fighting-man's point of view: they will not stop a charge, particularly a rush of savage or barbarian fanatics, so well as the old-fashioned, soft-lead bullets; because the shock when they strike the body is not nearly so severe. But, alas, in this war eight tenths of all wounds are from shell fragments which are as vicious and filthy as bullets are mild and clean.

The lion's share of the saving of life in war has been in the prevention of sickness on the field and in the tented camp. We are not yet able to say that war itself is a disease and preventable, though we hope that that day may come; but we can say that four fifths of its mortality, as waged in the past, was due

to preventable disease; and that disease is not only preventable, but is being actually prevented in most modern armies.

The sanitary conditions in the field up to the middle of the nineteenth century were something appalling. In the Thirty Years' War, from 1618 to 1648, all Central Europe was turned into a pesthouse; and, though less than sixty battles were fought in the thirty years, army after army melted and disappeared, from typhus, from dysentery, and the Black Death, from famine, from food poisoning, smallpox, and cholera.

The great Gustavus Adolphus, after one deadly winter in quarters, found himself practically without an army, and lost during the winter's rest more than ten times as many men as during the summer's campaign. There was no drainage, no vaccination, no method of preventing the spread of infection. There were no surgeons or medical corps, though a few of the generals and noblemen took their private surgeons into the field.

Even this painfully inadequate attempt to care for the wounded dates back only to the fifteenth century, in the campaign of Agincourt and the army of Henry V, five hundred years ago. The great pioneer of military surgery, Ambroise Paré, discovered on the field of battle the superiority of the silk-thread ligature to the cautery or hot iron for checking hem-

orrhage; but he served only in the capacity of private physician to the Duke of Guise. In the light of recent events it sounds like the echo from some nightmare to note that the campaign in which he made this famous discovery was the siege of Metz in the sixteenth century.

Even two hundred years later Frederick the Great declared that fever alone cost him more than seven great battles. This was hardly to be wondered at when we remember that, although there were regimental surgeons, they were very poorly equipped, and, what was still worse, were almost entirely unprovided with hospitals or nurses. Incredible as it sounds, hospitals were not considered a necessary part of army equipment until the time of Louis XIV. Voltaire describes these new and wonderful provisions of humanity as they were conducted in 1707 — again with a distressing reminder of a modern instance — at the siege of Lille.

Napoleon cared very little for his sick and wounded. He simply threw them into barns, outhouses, village hovels, or peasants' huts, left them there and swept on; but it was during his disastrous wars that the first clear instance of a really effective, working army medical service appeared, and that was in the English army under Wellington in the Spanish Peninsula. It was crude and imperfect, according to modern standards, but it kept down the disease death-

rate to a little more than half that of the French army. The fact made such an impression that even a military historian was struck by it, declaring that the work of the army surgeons had probably practically decided the result of the crucial battle by adding a full division to the strength of Wellington's army. A century later the Japanese deliberately calculated that they could neutralize Russia's superior numbers by keeping fifty per cent fewer men in the hospital.

The sanitarian is a powerful factor in modern war, though he gets few medals or promotions for it. The lesson appeared to have been soon forgotten, however, for in the next serious war — the Crimean, in 1854 — the English troops went into the campaign so badly equipped that their disease death-rate rose to the enormous figure of twenty-three per cent a year — more than four times as great as the battle death-rate. Thirty per cent of their eighty thousand men perished in the first campaign. Fortunately this horrible loss recalled them to their senses. A sanitary system was organized and equipped, at the head of which Florence Nightingale won her immortal fame. Camps were properly policed; food-supplies were improved; good hospitals were established; and the disease death-rate of the second summer campaign was reduced to less than a tenth of the first.

It was most significant that the first great victory in our permanent triumph over disease in war was won by woman; and she has been repeating the performance ever since; the nursing service, the Red Cross, the ambulance, and the field hospital would be impossible without her. Her courage and her devotion are equal to that of the fighting-man, for she actually faces the deadliest risks of war — disease, poor food, bad water, and privations.

And when the hospital comes under fire she goes about her duties unflinchingly, as steady as a veteran of the Old Guard. She hates war, not because she is afraid of blood, — there has been more blood shed bravely in the birth-chamber than on the field of battle, — but because she sees it for what it is. She is becoming more and more an influence to be reckoned with.

Woman has done wonders toward humanizing war — some day she will abolish it altogether. Our own American Civil War profited by this terrible experience; and, though coming only seven years later, succeeded in cutting the Crimean death-rate almost in two.

Finally, in the Franco-Prussian, the Spanish-American, and Boer Wars, the lowest death-rate from disease yet recorded was attained — that is, two and a half per cent. Even the brilliant and magnificent work of the Japanese medical corps in the



A GROUP OF LADY AMBULANCE-DRIVERS

war with Russia did not succeed in lowering this average more than a fraction of one per cent. Its real triumph lay in the fact that, instead of the war being waged, like most of our own Spanish-American War or the Franco-Prussian War, in civilized and temperate countries — four fifths of our war loss was on our own soil — it was waged in a densely populated, half-civilized country, reeking with filth, with scarcely a stream free from typhoid contamination, and sown from one end to the other with typhoid, typhus, smallpox, cholera, and the great Black Death itself in its most virulent form. To win under those circumstances a disease death-rate for an army of three quarters of a million men, for nearly two years, of barely two and a half per cent, equaling that of the Germans in their brief four months' campaign in one of the healthiest countries in Europe, was a triumph of which the Japanese medical corps is entitled to be proud.

The Japanese were the first openly to adopt the rule that the doctor's place is in the first line of the advance guard, with the scouts and cavalry patrols. Every well was tested and labeled hours or days before the main army reached it; and if infected it was guarded by a sentinel with fixed bayonet. Every village was rigorously inspected, cesspools disinfected, and all cases of infectious disease quarantined. Food brought in by foragers was examined

with the microscope and tested with reagents before it was used. Mosquito pools were kerosened, camp-grounds selected in advance and, if necessary, drained. Nothing was left to chance.

We had, indeed, good reason to reproach ourselves for our unnecessary waste of life in the Cuban campaign of our Spanish War, but this was solely on the ground that of the fifty-four hundred deaths from disease, nearly four fifths died on our own soil from one preventable disease — typhoid fever.

Our work in the Philippines was admirable, and our total death-rate from sickness during the whole war was small, — one of the lowest in history, — though, by contrast with the fact that it was more than five times as great as our losses in battle, it caused us much reproach and heartburning.

Our death-rate in battle, however, owing to the fewness of actual engagements and the guerrilla warfare that made up most of the campaign, was the lowest in recorded history — less than a half of one per cent.

Though we in America have had no wars since then till now, we have been able to assure ourselves of the high standard of efficiency reached by our medical and sanitary army corps against the dread enemy of the soldier, disease, by maintaining two armies in the field, each for a considerable period of time.

One of these was the army of observation encamped along the Mexican frontier during the whole summer of 1912. It was placed in much the same climate and circumstances — if anything slightly more unfavorable on account of the heat, poor water-supply, and infection from Mexican villages — as our army in Florida during the Cuban campaign. Fortunately for purposes of comparison the numbers happened to be almost identical — something over twenty-five thousand men in Florida in 1898 and about thirty thousand in Texas in 1912. The death-rate from disease in Florida for the season was two and a half per cent; that in Texas was about two thirds of one per cent.

A large share of this splendid reduction was due to the difference in one factor, typhoid fever, which caused something like eight tenths of the deaths that occurred in Florida, whereas of the thirty thousand troops in Texas only three men died of typhoid! The reason for this was medicine's latest and well-nigh greatest contribution to the saving of life in war-time — the discovery of a vaccine or protective inoculation against typhoid fever. Three injections of this at intervals of about ten days will diminish a man's chances of contracting typhoid, under the most unfavorable circumstances, to about one in a thousand for a period of from two to five years, and possibly longer.

The other sanitary triumph of our American army medical corps was the occupation of Vera Cruz. Thirty-five thousand men landed and took possession of a hostile city in the famous *tierra caliente* of Mexico, reputed to be one of the deadliest climates in the world and at the most unhealthy season of the year. The town reeked with malaria and was full of smallpox and dysentery. An active mosquito war was begun at once and the weapons used were kerosene, quinine, and ditches. Four fifths of the native population of sixty thousand were vaccinated within two months, with the result that both malaria and smallpox practically disappeared.

The city was cleaned, drained, and its water-supply purified, with the amazing result that, of thirty-five thousand soldiers, only one died of disease in three months; and the death-rate of the native population was cut in two. War no longer brings in its train famine and pestilence. Almost the only soldiers sick were those on outpost duty, exposed to flies and mosquitoes from Mexican territory.

These are fair illustrations of one of the most encouraging aspects of our great reduction of the death-rate in war — that its victories are won against the same enemies which cause our heaviest death-rate in time of peace.

From the point of view of disease, war brings no evils in its train, but merely aggravates and exag-



QUININE PARADE IN THE SALONICA ARMY

gerates by its overcrowding, poor drainage, under-feeding and exposure to wet and cold in temperate zones, and to the winged pestilence that carries malaria and yellow fever in tropical climates — the same diseases that mow us down in the times of peace. So the lessons learned on the tented field can be carried back and applied in the village and the town in the peaceful country.

In fact, we have recently been given one brilliant and superb demonstration of what can be done in peaceful enterprises, by carrying out the methods of military sanitation, in the triumphant building of our Panama Canal. We have already reduced the death-rate in the bloodiest war to less than half of that of absolute peace two hundred years ago.

Now, by the application of military methods to peaceful enterprises we have succeeded in lowering the death-rate of a body of over thirty thousand men and women — yes, and children — not merely in the tropics, but in the deadliest and most sweltering pest-hole in the civilized world and in all history, the Isthmus of Panama, to a little more than half of one per cent a year, which is less than half the death-rate of the entire population of the United States.

Of course, it was a picked group of strong, vigorous workers — both men and women — who had passed rigid physical examinations; but it is safe to say that it was a fair sample of what might be done for the

entire population of any State in the Union if General Gorgas were given there the same free hand he had in Panama to feed, house, and protect from infection.

War is horrible and will always remain so; but we have robbed it of some of its terrors within the last century. The next step should be to wipe it out altogether.

Modern war is forty per cent engineering, fifty per cent sanitation, and the rest strategy. An army, as Napoleon said, is like a serpent — it travels on its belly. Put your men on the fighting line in good health and in fair numbers, and, as Sherman said, "You need have no fear but they'll fight."

The whole science of war, as Forrest, the famous Confederate cavalry chief, pithily remarked, is "getting the mostest men there the fustest." The two things that most powerfully promote this result are transportation and sanitation. Other things being equal, the army that has fewest men in the hospital will win most battles.

An army with good doctors has a thirty per cent advantage over one with poor ones. Can the same be said of generals?

III

FEEDING A MILLION MEN

WHAT THE SOLDIER EATS

HOW a soldier will fight depends, first, on how he is armed, and, second, on how well he is fed. We hear a great deal about warlike and unwarlike races, about mild and peace-loving nations, and famous fighting strains; but almost any race, however tall or short, dark or fair, savage, half-savage, or civilized, if well fed, fairly armed, and halfway decently led and trained, will furnish a pretty fair article of fighting men, quite good enough for all practical purposes of warfare, whether mediæval or modern. Courage, like most other good things, is one of the most frequent of human virtues, and will come to the surface as soon as it is given a decent physical basis on which to stand. From the days of the Foreign Legions of Rome and the Janizaries of Constantinople to England's Ghurkas and Sikhs and France's Turcos and Senegalese, the dominant race has turned painted and nose-ringed savages into first-class fighting machines.

Even out of the most peaceful and sheeplike of races, like the Chinese coolies, Gordon was able, in three years, to form his famous Ever Victorious

Army, which never fought against odds of less than three and usually ten to one, but was never defeated, and which he expressed his perfect willingness to match against an equal number of any known European line regiments.

Explanations of the transformation have been varied and superficial — military drill, according to one opinion; superior weapons, to another; confidence in white officers, to a third. But the deliberate judgment of competent experts is that half the miracle was wrought by better food. That was Gordon's own explanation of the major part of his triumphant feat.

An army in the field seems to rest solidly on the ground; up to its knees in it, in fact, if the rains have been heavy. Practically, however, it is up in the air, supported by a tripod, one leg of which is ammunition; another, rations; and the third, sanitation. Knock any one of those legs from under it, and it goes down, flop, like a bird with a broken wing.

We hear much of the tremendous problem of mobilizing an army, of assembling and entraining troops, and massing them on the frontier in three, five, or seven days from the declaration of war. It is a tremendous and difficult feat; but it is merely a summer holiday compared with the exhausting and never-ending problem of feeding them after getting them there, which becomes still more difficult as they march into the enemy's country.

It requires a tremendous number of troop trains to deliver an army of two hundred thousand men on the fighting line; but when that has once been done it is over and seldom needs to be repeated on the same scale, fractional units only, as a rule, being moved at intervals of several weeks or months.

Each of those two hundred thousand men, however, eats his own weight in food every thirty days; and that means a never-ending succession of freight and supply trains, pouring constantly backward and forward all day and all night, as long as the war lasts. And there can be absolutely no let-up in this toilsome service, no excuses for breakdowns, no breathing-spells or vacations. That rumbling, lumbering, never-sleeping line of communication is the very aorta of an army — the great artery through which pours its life-blood.

In the early days the problem of rations was a comparatively simple one, for each soldier supplied himself, carrying enough at his saddlebow or in his haversack to last him until he got into the enemy's country, when the rest was easy. War, in the beginning, was systematized robbery and plunder; and it has not changed much even in this twentieth century. The principal inducement to go to war was the excellent excuse it gave for plundering and looting, and living off the country generally.

So vitally important is food to an army that any-

thing which hinders a soldier from utilizing to the full his ration disqualifies him at once. In modern recruiting offices more applicants are rejected to-day for defective teeth than for any three other defects. This seems little short of absurd to the non-expert, and one can hardly help sympathizing with the recruit who a few weeks ago volunteered for service in England. He was a bony, sturdy Scot and could hardly believe his ears when told he was rejected. The examiner regretfully explained that the only cause was his decayed teeth. Fixing a dark and reproachful gaze on the officer, he exclaimed:—

“Mon, ye'r' makkin' a gran' mistak'. Ah'm no wantin' to bite the enemy, ah want to shoot 'im!”

Moreover, wars were formerly casual, fitful affairs, and lasted only so long as the food-supply of the invader and invaded held out, then collapsed of their own accord. In those days the best soldier was the man who could go longest without food or live on the coarsest and cheapest foodstuff. The inhabitants of the rich plains and fertile valleys were perpetually being harried by swarm after swarm of hill-men and mountaineers, caterans, moss-troopers, night-riders, and banditti, who came down, hungry and steel-clad, out of their wretched fastnesses once or twice a year for a square meal.

The earliest commissariat started, for obvious reasons, with a decidedly restricted, solid — not to

say stodgy and unattractive — group of food fuels. Foods, to be suitable for army supplies, must, of course, be of proved and high nutritive value. They must be as compact as possible — that is to say, have as much nourishment for their bulk and weight as feasible, so as not to cost too much for transportation. And they must be in such form as to keep well and stand considerable variations of climate and vicissitudes in handling and storing without spoiling.

Naturally a few *pièces de résistance*, as the French call them, poked their heads into the limelight at once — salt meats, particularly beef and pork; hard biscuit; flour, beans, and fat. The judgment that selected these staples was sound; and to this day the bulk of army supplies, particularly for a rapidly moving force — its backbone or principal staples — consists of salt beef, salt pork, bacon or ham, hard-tack, flour, rice or corn meal, beans, and butter.

It was soon found, however, that though a ration of salt beef or pork, with wheat, rye, or barley bread, and fat, furnished the essentials of a diet and supplied the necessary fuel units or calories in as compact, durable, and transportable form as could anywhere be discovered, it had certain very serious draw-backs.

Of course, it is only fair to remember that these articles of food were never intended to form, so to speak, more than the backbone of the ration; and

that lighter, less nutritious and more perishable things, like fruits and vegetables and sweets, were expected to be secured from the enemy's country. But with the wanton and reckless methods of waging war, setting fire to standing crops, hacking down orchards, burning stacks and granaries and barns, and pillaging and murdering non-combatants — which until recently we thought we had outlived — a country much fought over soon became such a desert that armies were compelled to live on the rations given them. And the moment they were so restricted for more than a few weeks they began to go down like sheep — partly with ordinary diseases, like typhoid, dysentery, pneumonia, and so on, which flourish on a lowered resistance, and partly from a perfectly definite and unique disease called scurvy, or scorbutus, due entirely to the absence of certain elements from the food.

So serious and so rapid were the ravages of this disease that in the Middle Ages it was no unusual thing for an army to have one third, one half, or even two thirds of its rank and file prostrated by it, and from a tenth to a fifth killed.

For centuries scurvy was supposed to be merely one of the innumerable plagues and pestilences that sprang up in the track of war; and it was not until about two hundred years ago, just before the time of Captain Cook's voyages round the world, that we

discovered that this loathsome and deadly disease, which loosened the teeth in the jaws, caused the joints to swell and become inflamed, and simply melted the walls of the blood vessels, letting hemorrhages leak out all over both the inner and outer surfaces of the body, was due solely to the absence of fruit acids and vegetable alkalies from the diet, and could be absolutely cured or prevented by such a simple charm as an ounce of lemon juice or half a raw potato a day for each man.

By this time scurvy had become practically confined to ships' crews, both in the navy and in the merchant marine. So lemon juice or lime juice was ordered by law to be added to all ships' stores; and for several generations afterward the old merchantmen that sailed round the Horn were known as "lime-juicers," from the fact that they were required to carry a regular stock of that life-saving article.

For fifty years — indeed, practically for a century past — the civilized army ration has contained not merely bread, meat, and fat, but either fruits or vegetables, and usually both. This modification was, however, brought about in a rather curious and indirect way. For many years, and even now in some armies, no vegetables, fruit, or sugar appeared in the formal list of supplies issued to the troops.

At first sight it would appear as though these were not considered to be needed in the ration. And

anything more uninteresting than the list of so many ounces of bread, so many grams of beef, with or without bone, so many ounces of lard, grams of sugar, and grains of salt, can hardly be imagined. It sounds as bleak and unattractive as a prescription.

When, however, you read between the lines and peruse the supplementary regulations, you will discover that though, with the rigidity characteristic of the military mind, no departure has been permitted from the sacred and time-honored list of solid slabs of food handed down from Mount Sinai, these are issued to the soldier in such amounts that he cannot possibly eat the whole of his ration, and is graciously permitted to sell or exchange the surplus for fruits, vegetables, sweets, and such simple luxuries as he may crave.

It is a clumsy old survival of barbarism, redolent of the times when barter was the only basis of exchange, money was scarce, and bills of sale were unknown; but it is supposed to put the soldier or mess sergeant on his own responsibility, and it saves brain-fag in the adjutant general's department.

It has, however, become largely a matter of form or a make-believe game of bookkeeping, for the full excessive ration is seldom actually issued. Each company or mess is credited with so much money expressed in terms of beef, pork, and flour, and it

is permitted to spend the value of whatever surplus remains for fruit, fresh vegetables, canned goods, sweets, pastry, soft drinks, and so on, either at the army stores or in the local shops.

Indeed, the majority of modern armies stock and supply their commissariat departments with a splendid variety of the very best quality of all sorts of not merely groceries, fruits, and vegetables, but even delicatessen relishes and minor luxuries, which the various messes are allowed to select to the amount of their surplus bread, beef, and pork, at the ruling prices of those staples.

Another thing discovered by our experience with scurvy is that our quick-growing, instinctive distaste for salted or preserved meats, if served for more than one or two meals a week, or for a few days or weeks at a stretch, has a sound physiologic basis. Though the surest provocative of scurvy is absence of fresh fruit or fresh vegetables from the diet, there are other forms of anæmia and blood impoverishment, as well as serious nutritional disturbances, that are much less likely to occur if the meat in the ration is provided fresh instead of salt.

Practically every modern army now issues its meat ration in the form of fresh beef or mutton and, where it can, supplements it with fish — though, of course, relying to a great degree on bacon or salt beef in the exigencies of a campaign.

This has made a great improvement; but there was still something lacking. And though it was always considered good strategy to encourage soldiers to forage as much as possible from the countries through which they passed, it was found that, on a diet of simple bread, meat, and fat, cravings for variety and other foods developed to such a degree as either to impair the health of the troops or make them so ravenously hungry for all sorts of desserts and trimmings that they devoured eagerly every kind of indigestible and unsuitable green stuff and sweet stuff they could get.

This craving was found to be particularly keen for sweets of all sorts; and as soon as the new-found luxury, sugar, became cheap enough to be available for army supplies, it was tested out with fear and trembling, and found to be not merely free from danger, but an extremely wholesome, digestible, and readily assimilable food; and it was added to the army ration.

Practically all modern army rations now, particularly the emergency ration intended for the support of bodies of troops in the field, away from their supply trains, contain sugar, not merely by the ounce, but by the pound. The modern emergency ration, for instance, consists of sugar in the form of chocolate, bacon, pork, fat, dried albumen, made either from white of egg or curds of milk, and a sort of pea-

meal sausage, containing dried peas, beans, or lentils, combined with flavoring herbs — the latter made in Germany and of a surpassing nastiness.

These ingredients are mixed together into a solid cake, which may be eaten raw or cooked, or else combined with water and made into a sort of sweet soup; and sometimes they are used in separate slabs. The soldier greatly prefers the latter arrangement, as it enables him eagerly to devour the chocolate, fry and eat the bacon, and throw away the pea-meal sausage.

Another substance found very satisfactory as an emergency ration is the famous and hallowed pemmican of our boyhood days, when we adore James Fenimore Cooper. This consists of meat of some sort, either beef, pork, or mutton — it was originally, of course, made of venison or buffalo meat — mixed with sugar, raisins, currants, dates, prunes, or other dried fruits, packed into canvas or leather bags, which are filled and sealed over with melted fat. It may be eaten in chunks, with bread or biscuit, or made into an appetizing and nutritious stew.

The army ration has given the finishing blow to our ancient nursery superstition about the unwholesomeness of sugar and the way it makes our teeth decay, and our livers become enlarged, and our joints inflamed with gout and rheumatism, and our kidneys "Brightsy." It is one of the best, most

readily digestible and, at present prices, cheapest forms of body fuel we have. Three quarters of the work of the body is probably done by burning sugar in the cells of our muscles, which later turn it into alcohol and explode it in much the same way that gasoline vapor is exploded in the cylinders of an automobile — only the cylinders are so innumerable and so tiny that we do not hear any chugging and do not get the familiar smell.

This brings the army ration or fuel supply of the fighting machine down to practically an irreducible minimum of five main type-fuels, lacking any one of which disease and breakdown are certain — bread, beef, fat, sugar, and either fruit juice or vegetables.

Even such a trifling ingredient as salt is absolutely indispensable, and its absence is instantly felt. On one of its wonderful fast forced marches, which established the world's record for infantry, a division of Stonewall Jackson's famous "foot cavalry" left its wagons so far behind that it was forced to live for three days on nothing but green corn, picked and roasted in the field. When the men struck the supply train their first wild rush was for the salt barrels, which they stove in at once; and, scooping up the salt in handfuls, they licked it up as eagerly as colts eat clover in a clover field.

The next problem was: Can any of these be

exchanged for something either cheaper or better adapted for transportation and keeping? Experiments in this direction have been innumerable; but the net result has been to leave the foundation stones of army diet pretty much where they were in the beginning.

Beginning with bread, every imaginable grain, nut, root, pith, or pulp that contains starch has been tried out as a substitute for it, because these are either cheaper in proportion to their starch content than wheat or can be grown in climates and latitudes where wheat will not flourish. Corn has been tried in the subtropics, rice in the tropics, oats, rye, and barley in the north temperate zone, potatoes, sago from the palm, and tapioca from the manioc root.

Only the net result can be given here, which is that no civilized nation that can raise the money or provide the transportation to get wheat will allow its army to live on any other yet discovered or invented grain or starch. Rice, ~~corn~~ meal, potatoes, sago, and tapioca are, of course, ruled out at once, because they contain only starch and nothing to match in the slightest degree the twelve or fourteen per cent of gluten, or vegetable meat, that gives wheat its supreme value.

After our first food analyses a desperate attempt was made to substitute corn for wheat, because it

contained from five to seven per cent of protein, — called zein, — a perfectly good protein in the books and in the laboratories; but it simply would not work in the field. Armies fed on it promptly showed signs of nitrogen starvation; and, about thirty years later, up came our physiologist with the belated explanation that, though zein was a right-enough protein in composition and chemical structure, only about a third of it could be utilized in the human body.

Even the purely Oriental nations — the Japanese, Chinese, and Hindus — born and brought up on rice, have formally abandoned it in their army ration and have endeavored to substitute wheat for it, though expense and the inborn prejudices of their soldiers have proved considerable obstacles. Troops or nations fed on rice are subject to beri-beri and are cured by a diet rich in protein, either vegetable or animal, wheat or meat. Meat and wheat in the ration have wiped out four fifths of the beri-beri in the Japanese army and navy. Those fed on corn become subject to pellagra, which is ravaging our Southern States to-day.

As for the northern grains, barley, rye, and oats, which also contain some gluten, these are all inferior to wheat — rye and barley on account of their low protein content and considerable bulk of innutritious, gelatinous, and gummy materials, which disturb the digestion; and oats on account of the irritating bitter

extractives with which their high percentage of protein is combined. Nobody but a Scotchman can live on oatmeal as his sole breadstuff; and it has taken generations of training and gallons of whiskey on the side to enable even him to do it.

The successful growth and colonization of the white races depend principally on whether wheat will grow in the climate in which they try to live. The temperate zone is simply the wheat belt and the grass-and-beef belt — the only region in the world where men can live and grow without suffering from nitrogen starvation. "Good as old wheat!" is an even higher standard of praise than our farmers realize.

The next foundation stone, for which the economists endeavored to substitute something else, just as good and far cheaper, was beef; and that noble stand-by holds its own like the Rock of Gibraltar. No other kinds of meat — venison, fowl, game, fish, or other animal substances — would take its place for a moment; partly because they are lacking in certain elements necessary for nutrition and partly because they contain some poisonous flavoring substances, extractives or split proteins, which promptly upset the digestion and the health when they are used as steady articles of diet.

Fish, for instance, has less than half the fuel value of its own weight in beef, and later researches have

shown that half, even of that fuel value is incapable of digestion in the human stomach. Chicken and feathered game of all sorts are simply trifles, as well as extremely expensive; in fact, the only flesh that can for a single month or even week be substituted for beef is pork.

Several years ago I happened to meet in eastern Oregon a prosperous and successful man of affairs who in his youth had been employed by the Union Pacific as a hunter to supply its construction camps, when building the railroad across the Great Plains, with wild meat — buffalo, venison, antelope, and elk. He told me that, at first, the men simply reveled in these luxuries; but that after the first week or so, if they were compelled to go for a single week or even three days in succession without their pork or beef, they threatened a mutiny. He summed up his experience in one sentence: "I tell you, doctor, there's only one meat that's fit for a white man to live on, and that's beef, with pork for a second choice."

Any one who has been on an extended hunting or exploring trip and run short of bacon will cordially indorse this remark. The finest of salmon or trout, of venison, partridge, pheasant, or quail, becomes as sounding brass or a tinkling cymbal in contrast with plain boiled beef or fried bacon.

A gentleman who had acted as volunteer cook for

a hunting party of his friends in the Olympics of the North Pacific Coast told me he could fairly cover the camp table with clams and broiled salmon, and fried venison and roast duck; but, after the first ten days out, if clams, salmon, venison, and duck were the only things on the board, up would go noses and voices at once in the complaint: "What's the matter with you? Are you gettin' too lazy to cook a little bacon?"

For campaign purposes, as an indispensable staple, bacon is perhaps even more valuable than beef, because it is twice as nutritious in proportion to its bulk, will keep in any climate, can be cooked any old way and yet be good, may be dropped in the river, run over by an ammunition wagon, rolled on by a mule, left out in the rain all night or in the sun all day, and yet be perfectly good chuck — yes, "hyas skookum chuck" in the Chinook jargon, "heap bully good grub" — when cleaned, trimmed, and fried.

Besides, it has the great advantage of containing the second of the indispensable elements — fat — as well; and it can be used for frying or as shortening in bread or biscuit. Blessed be bacon! Like beef, it boasts the one great and only unmistakable earmark of permanent value — you can eat it once a day all the year round and never tire of it.

As for any of the vegetable substitutes for meat,

such as beans, peas, or lentils, to know them is to loathe them. They are rich in protein and very cheap; but alas! they contain bitter alkaloids and extractives, so intimately blended into their proteins that no known methods of steaming or cooking will get rid of them. You may bake, you may batter the bean as you will, but the taste of the horehound will hang round it still. These disagreeable alkaloids are not only bitter but poisonous, upsetting the digestion and impairing the health. This is why neither Tommy Atkins nor his American cousin will stand for pea-meal sausage in the emergency ration, though as vegetables and for variety in the diet, beans and peas, both dried and canned are excellent; and the famous pork-and-beans can be used as solid nutriment for two or three meals a week, but not oftener. Boston was wise — as usual — when she set the habit of eating her sacred beans only on Saturday night and Sunday morning.

But is even this dietetic trinity of bread, beef and sugar, with greens and dessert on the side, sufficient? The results of a hundred campaigns have shown that it is not. Man is not merely a stomach and muscles — he is also a bundle of nerves; and they require their share of pabulum. In the early days the nerve-steadier in the soldier's diet used to be supplied in the form of grog — beer, wine, whiskey; and up to about one hundred years ago alcohol in some form

was considered to be an absolutely indispensable part of the army ration.

Gradually, however, and by bitter experience, it was realized that alcohol's way of steadying and supporting the nerves was to narcotize them, which practically means poison them; that it gave no nourishment to the body and, instead of improving the digestion and utilization of food, really hindered and interfered with them. Man must have something to drink as well as to eat; but what can be found as a substitute?

About two centuries ago two new planets swam into our human ken above the dietetic horizon — tea and coffee. They were looked on with great suspicion at first, partly because they were attractive and partly because they were new. They were denounced by the Puritan because they were pleasant, and by the doctor because they were not in the pharmacopœia; but, in spite of bitter opposition, they won their way.

It is doubtful whether any addition to the comfort of civilized man within the last two hundred years in the realm of dietetics can be mentioned that equals them. Certainly, if we take into consideration the third new article of food, which came in and still goes down with them — sugar — it would be impossible to match them with anything of equal value.

Every army in the world to-day has either tea or coffee, or both, as part of its ration. Their advantages are, briefly: First, they probably provide the nerves with a sort of ready-made food — our laboratories have not discovered this fact yet, but they will, as they have so many other explanations for and justifications of what our instincts knew first. Second, tea and coffee add enormously to the attractiveness of the meal and to our ability to eat with relish and appetite large amounts of solid foods. No matter how coarse or unattractive the ration, providing it has decent fuel value, if it is trimmed and washed down with plenty of hot, well-sweetened tea or coffee it will fill the bill and keep the mess in fighting trim.

Third, — and this is a very important point, — they unconsciously lead the men into the habit of taking the greater part of their drinking-water boiled. Not only is tea or coffee the main beverage at mealtime, but the men get into the habit of filling their canteens, before starting on the day's march, with cold tea or cold coffee, and thus are saved in large measure from the temptation of drinking from wells, streams, or ponds, and thus running the risk of typhoid or cholera.

It was the opinion of both the American and the English army medical men who accompanied the Russian and Japanese armies in their late war that

the habit of drinking hot or cold tea, almost to the exclusion of any other beverage, was largely responsible for the surprisingly low typhoid rate that obtained in both armies.

Last, but by no means least, tea and coffee have practically driven beer, wine, whiskey, or any form of alcohol out of the field. Our own American ration in both army and navy includes no form of alcohol at all, but only tea and coffee. Most of the European rations still include alcohol, but only for use in special emergencies, such as the chill gray dawn in the trenches; and the change has been greatly to the benefit of the soldier physically, mentally, and morally.

As for the injurious effects alleged to be produced by tea and coffee, the explanation appears to be that they belong to the so-called poison foods, those curious substances which, though perfectly wholesome and harmless for ninety-nine people out of a hundred, are definitely harmful to the hundredth man. Somewhere from one to three per cent of the community are distinctly injured and poisoned by tea or coffee, even small amounts producing burning of the stomach, palpitation of the heart, headache, eruptions of the skin, sensations of extreme nervousness, and so on, though the remaining ninety-seven per cent are not injured by them in any appreciable way if consumed in moderation. If tea or coffee poisons

you, let it alone. But for heaven's sake have the grace to be ashamed of your infirmity and don't start a crusade to prevent normal, healthy people from having it just because it does n't agree with you. Least of all try to foist on them some ghastly, sloppy substitute like post-mortem serial or other like atrocities.

Altogether, the army ration closely approximates the menu of a well-supplied private home table. Not only must there be plenty of the three great staples, — bread, meat, and sugar, — but also a good variety of fruits, vegetables, puddings, pies, cakes, and other trimmings of various descriptions. Since the introduction of sugar in commercial amounts, and the consequent development of methods of canning and preserving, the average modern army now takes the field with a really splendid variety of canned vegetables, canned fruits, oysters, canned meats, — particularly in the form of canned corned-beef hash, — preserves of all descriptions, and dried fruits, also chocolate and pure candy by the ton; and sets for its men a table that is in no respect inferior, either in nutrition or attractiveness, to that of the average three-dollar-a-day hotel.

This change is not limited or confined to any one nation or group of nations. All over the world, wherever men feed and fight, their commissariat department endeavors to supply them with substantially the same diet and trimmings. The amusing super-

stition, for instance, eagerly spread about by our vegetarian friends, that the Japanese army in its campaign against Russia fought on a diet of rice, vegetables, and salt fish, was exploded long ago. For thirteen years before that war, and in deliberate preparation for it, the Japanese army and navy had been living on a ration containing beef, wheat flour, sugar, pork, butter, and apples, modeled as nearly as circumstances and convenience would permit on that of the English, French, and American armies.

It is true that, during the stress of the campaign, the supply of beef fell off somewhat, and that the newly levied troops objected to eating wheat bread in place of rice; but in the main their victorious campaign was fought on as near an approximation as was practical to the European army ration.

The same curious inflexibility of the ration has been found in campaigns in tropical climates. When we first began seriously to consider and scientifically to study our foods, it was customary to assume that tropical races, having lived for generations in tropical climates, had gradually hit on the ideal diet adapted to those conditions. So, when our Northern soldiers were sent into Africa, India, Asia, and the Philippines, an attempt was made to get them to live on the diet of rice, fish, and vegetables on which the natives maintained an existence.

It was supposed that a hot climate, not calling for so much heat production on the part of the body, made a lighter and less nutritious diet advisable. And the frightful mortality which often affected Northern European troops in tropical stations was sometimes attributed to their insisting on eating large amounts of meat, fat, and other "heating" foods, which they had been accustomed to eat in their home climate.

Two facts, however, have stood out from the very beginning of careful study of this matter: First, that at least ninety per cent of the disease and mortality, particularly of the intestines and liver, which had been so constantly attributed to ill-chosen food, was due to infectious disease; and that the moment the germs of disease were excluded the mortality and high sickness-rate almost disappeared. Screening the windows, draining the ponds, and filtering the drinking water, for instance, cut down at once four fifths of the tropical diseases, malaria, typhoid, cholera, dysentery, etc., to which our Northern troops fell victims. Food had absolutely nothing to do with it, except in so far as it was a means of carrying infection.

The second thing was that, though the natives of the tropics could get along fairly well at their own level of living and rate of expenditure of energy on their tropical diet, the moment they were put to any

task that called for strenuous and continued exertion they broke down at once. If, however, before they were called on to do white men's work, whether as native troops or as laborers on railroads, canals, and so on, they were put for a couple of weeks on a full white man's ration, the breakdown did not take place.

It has now been shown in every climate in the world — most strikingly in the building of our Panama Canal — that native laborers, placed on the full Northern army ration, plenty of beef, pork, sugar, and wheat bread, would increase their working power twenty-five, thirty-five, or fifty per cent within six months; and at the same time, instead of developing stomach and liver disease from over-eating, they would become healthier and stronger and less subject even to the tropical infections among which they live.

In other words, tropical races live on a diet of rice and vegetables for one reason, and only one, and that is poverty — which, by the way, is the only real cause for any of the spare and exclusive diets of mankind in any part of the world. The minute the most famous vegetarian races can get their hands on meat and fat, they devour them eagerly and improve enormously in both working power and health.

The tropical ration for European or American armies now consists of practically the same staples

that are used in the North, with a little less meat on account of its power of raising the body temperature, a little less fat, and somewhat larger amounts of sugar, fruits, and vegetables. If the army is to take the field and make forced marches, climb mountains, wade rivers, and lie out in the open, it requires just as full and abundant a ration of meat, fat, and wheat bread as it does during a Northern campaign in a temperate climate.

A large share of the alleged indolence, fatalism, and lack of energy in the peoples of the tropics is due to the fact that they are underfed, and particularly starved of protein, and the balance to malaria and hookworm. Plenty of meat or other protein, mosquito nets, spades, and drain tiles will enable the white race to colonize any part of the tropics, provided some mountain resort can be brought within striking distance by rail, where the women and children may be sent during the heated season and the men may spend two months or more out of each year, assisted by proper travel and vacations in temperate climates.

Not only does the most scientific, up-to-date army ration match, as to its composition, the kind that mother used to cook, but it is approaching it as rapidly as possible in methods of cooking and serving. In an early day each soldier carried not only his food-supply but also his cooking utensils on his back or

at his saddlebow, squatted down in the dirt, and literally "messed" for himself.

Echoes of that Golden Age still linger; and even in textbooks on military hygiene you will find regretful allusions to the days when the Scotch Borderer rode down from the Grampians on his shaggy pony, with a bag of oatmeal, a little salt, and a sheet-iron griddle-plate hanging at his saddle for his entire commissariat department; or to the famous Arab cavalry, which would start on a three weeks' campaign with a bag of parched barley on one side of the saddle and one of dried dates on the other.

These gentle adventurers expected to steal most of their food; but, though they could make a campaign after a sort on such chicken feed, they could not have stood up before a modern bayonet charge for two minutes on any such trash. If they happened to be kept in the field for more than three or four weeks three quarters of them never went home, but died of typhoid, cholera, dysentery, and other filth diseases.

The modern soldier, of course, still carries his mess-tin, pannikin, knife, fork, and spoon; and the things he cannot cook and eat with this excellent rough-and-ready outfit would make a very short list indeed. The mess-tin is a particularly admirable utensil of oval shape, about the size and depth of an ordinary pie tin, made of the thickest block tin,

which means, of course, sheet iron thickly plated with tin. It has a lid or cover and also a handle, hinged to it, which can be folded over it when it is closed. Put on the cover and you have a good small Dutch oven or baking-dish, which can be buried in the coals; straighten out the handle and you have an excellent frying-pan, in which both biscuits and bread can also be cooked.

The pannikin, or cup, is made in one piece, also of the heaviest block tin, holds more than a pint, has a folding handle and will boil anything that can be boiled, from coffee and tea to beans and onions — except, of course, rice as tackled by the raw recruit. A classic story is told of a green soldier who, finding a pound of rice in his ration, proceeded to cook it for supper. He poured it all into his quart cup, covered it with water, and put it on to boil. When it started to swell it began to erupt gently and flow over the side of the cup into the fire. In alarm he spooned out the top layer into his tin plate; but the can was full again before he could turn around. Next he ladled his frying-pan full, and then filled his tin cup. Then he filled the pie tin and the water dipper, until finally every utensil in camp was full to the brim. Still the rolling flood of rice pudding rose and swelled and majestically overflowed.

Inside the mess tin are three canvas bags for salt, sugar, and coffee; and in the haversack there is a

ration of bacon, bread, and beans. This outfit is intended only to make the soldier self-supporting for a few days, or a week at the outside, when he leaves his baggage wagons behind or is separated from them. The plan now is to cater and cook for an army in the field almost as carefully and in as appetizing a manner as in garrison or at home. Instead of dividing the men — on the ancient and venerable method that was one of Sparta's contributions to the art of war — into messes of eight or ten, one of whom would volunteer or be commandeered as cook, — which was probably the origin of the classic epigram, "God sends meat, and the Devil sends cooks!" — the unit of the cook supply is either the company, as in the United States Army, or the battalion, as in most European armies.

The army cook is a well-paid, trained expert, who has either learned his profession in private life or been sent to one of the old schools of cookery maintained by the army. The United States Army, for instance, had three of these — one in the East, one in the South, and one in the West. He has for his company — ranging from sixty men in time of peace to one hundred or one hundred and ten on a war footing — a staff of from one to three assistants, two cook's police, and a helper or two.

In the early days a cook had to be an inventor as well as a mechanic; and stories are still told of famous

army cooks who could make bread, ready to eat within twenty-five minutes, out of flour in the barrel, without pans, cooking utensils, range, or stove. Their method was to knock in the head of the barrel; scoop a hole in the top of the flour, pour into this hole water, with salt and, if available, baking powder or yeast; mix up the dough in this flour-lined kneading pan and pat it into flat cakes, knock one or two barrels apart, sharpen the staves at both ends, cut them in two, stand the dough cakes before a roaring fire on these shingles, and, when done on one side, turn over and roast on the other.

To-day, however, the army cook takes the field with a portable sheet-iron stove, into which, telescoping into one another, fits a full equipment of pans, kettles, boilers, and dishes of all sorts. This stove is quickly set up; the pans, as emptied out, are passed round to his helpers; and within thirty minutes he has a full outdoor kitchen improvised, that needs only an awning stretched over it to make a regular cookhouse.

Most of the present armies, notably the English, go farther than this, and have regular portable kitchens or cooking-stoves mounted on wheels and drawn by one or two horses, or driven by motors, which accompany each battalion in the field. These kitchens are provided not merely with a fire-box and cooking-utensils, but also water-tanks and caldrons

with waterproof lids, which can be screwed down so that a meal can be started before breaking camp and continue cooking while on the march. The moment the army stops, all that is necessary is to take off the lids and serve the soldiers a hot, steaming meal.

These portable kitchens also have the great advantage of keeping the army, while on the march, constantly supplied with hot water from which tea, coffee, soups or broths may be made.

The United States Army now provides a capital special manual for army cooks, which gives careful directions for the most appetizing and attractive methods of cooking the different elements of the ration and the best ways of serving; insists on the most scrupulous care in keeping dishes and utensils of every sort spotlessly clean and sweet, and so on. Complete and most appetizing recipes are included for mincemeat, lemon pie, ice-cream, pineapple ice, corn fritters, layer cake, crullers, potato salad, clam chowder, crab-meat stew, and other things that fairly make the mouth water.

The elaborateness of providing and serving the army ration is not a sign of the growth of luxury or effeminacy — it is a matter of the highest economy and best possible strategy, as well as of investment; because men will march better, fight better, drink and dissipate far less on an abundant, varied, well-cooked, hot, and attractively served diet than they

will on bacon and hard-tack cooked in the ashes — which means in the dirt — and served on sticks or slabs of bark.

Everybody who has had experience in camping knows that camp cookery and men-folks' amateur cookery generally are simply a dirty and rather disagreeable form of mitigated starvation. It is all very well to live on camp diet when you are simply loafing and amusing yourself; but when you try to work on it it soon blows up — or, rather, you do. Lumber camps, railroad gangs, and engineering camps of every sort and description now give as rich, liberal, varied, and well-cooked a diet as can be found anywhere in civilization — not out of philanthropy, but because it pays.

One of these days a nation or a community at peace will study its food-supply, arrange for its proper production in the most appropriate soils and climates; its shipment with the greatest economy of movement and least possible expense; its handling and storage with the highest degree of cleanliness and economy; and its distribution to the consumer in good condition and at a low price — in the same way that an army commissariat department now supplies its troops. When it does this we shall see an increase in national efficiency, in working power, in health, and in happiness of at least thirty-five per cent within thirty years.

IV

THE SUPERB HEALTH OF THE ARMIES

I HAD the good fortune to be in Paris on the 14th of July, France's National Day, which she keeps as religiously as we do our beloved Fourth. It was celebrated this year (1917), by a great review of troops at the Cour de Vincennes, not sham-battle soldiers, but real ones — veterans of nearly three years of fierce, incessant campaigning.

New colors were presented by the President of the Republic to some sixty regiments that had distinguished themselves on the Field of Honor. Each regiment sent up a company to receive its trophies and serve as a guard of honor, and then to march proudly through the crowded and cheering streets of Paris, bearing their new colors, making a total of over eight thousand men in line. It was one of the most magnificent and cheering spectacles I have ever seen — not merely from a patriotic and fraternal point of view, but also from a physical and scientific one.

It would be impossible to imagine a more continuous and unbroken stream of splendid health and physical vigor and endurance than these war-worn veterans presented. After the storms of blood and

fire and shell rain and poison gas which they had been through; after the magnificent fight that they had kept up for almost three years, in the beginning against overwhelming odds, one might well have expected to see faces lined and worn, eyes sunk and grave, though bravely resolute, shoulders a little bowed by the burden of the years of war. But here they came — these heroes of a hundred bloody attacks and counter-attacks, these veterans of Verdun, of the Marne, of the Somme, with the bright eyes, the fresh color, the cheerful smile, the free elastic gait, of a band of college students celebrating a football triumph. The eyes were steadier, the jaws a little squarer, the whole set of the face and carriage more purposeful and dignified, but for sheer splendored joy of living and fearless sense of readiness and fitness for anything, they could not have been surpassed by any intercollegiate team of athletes. They had seen the horrors of war, they had looked death in the face a thousand times, but it had neither saddened nor depressed them.

I looked about, right and left, at the faces that lined the street on either side and behind me — faces for the most part of sturdy, vigorous, laboring people, who had come in from the outer suburbs and surrounding country for the great event. I passed in review, before my mind's eye, the crowds who would throng the streets at home on a like celebration.

And it would have been utterly impossible to have picked out, from even the most vigorous and hard-working of peaceful spectators, any such body of joyous, clean-drawn athletes as were marching in horizon-blue uniform and steel helmets, with shining, fixed bayonets down the street.

The day was close and sultry, the streets jammed and packed with a perspiring crowd. The place where I stood was a good two miles and a half from the review ground, and the men were marching in full field uniform, with long, heavy overcoats, great steel helmets on their heads, with rifles, fixed bayonets, and ammunition belts. Yet they fairly danced along, as if they were enjoying it, every foot of it. It was one of the most magnificent and cheering demonstrations of the everlasting resiliency, the utter irrepressibleness of the human physique and of the human spirit.

If any one imagines, as would not be unnatural, that three continuous years of the hell of week-long bombardments and of the bitter and unheard-of hardships of the trenches must have worn the nerves and wearied the spirits of the long-suffering army, one good look at the ruddy, cheerful faces, the broad, square shoulders, straight backs, and lithe, elastic limbs of those joyously marching columns would be a convincing revelation to the contrary.

Incidentally, on the other hand, though this is not

perhaps sticking strictly to the professional last, it did one good to see how the temper and spirit of the crowd met and matched that of the fighting men. Everywhere shone the same high courage, the same proud endurance, the same confidence of ultimate victory. Though the brave, sad eyes of the women haunted one at every turn, and a plain black band on many a coat-sleeve told of bitter bereavement, yet the memories of their sacrifices simply strengthened and deepened their pride and joy in the splendid army which they had put in the field and were supporting there, and hardened their determination to continue the slowly but surely winning fight to final triumph.

Nor is this cheering condition confined to the crack or picked regiments. I have seen hundreds of regiments, thousands of platoons, in their camps, on the exercise grounds, marching along the roads, going up to or coming back from the trenches at the front, changing lines from one army to another, entraining and detraining at the great railroad stations, and never have I seen anywhere, in forty years' careful and affectionate observation of the *genus humanum* in time of peace, such a vigorous, free-moving, clear-eyed, fresh-colored set of athletes in the literal "pink of condition"!

The thing is so universal that it is overwhelming — from Sheffield to Soissons, from Melbourne to Mes-

sines, the shock of sheer pleasure, to the eye of the physical trainer, from the swinging ranks of every regiment that one sees on the march. One gets actually to look out for the exceptions, to think of each rippling line of horizon-blue or khaki that one meets streaming down one side of the crowded road, while the flood of artillery and transport pours past along the other, "This one is going to be the exception — here come the misfits, that have been kept in the background — these men will show the combings of conscription or the hardships of the trenches, the nerve-strain of the thundering bombardments." But each time you are agreeably disappointed.

Ruddy, sweating, and leaning well into their pack-straps, caked with mud or powdered with dust, still they were covering the ground easily, and in workmanlike fashion, from the hips, heads up, eyes bright, foreheads unwrinkled. Cheerful, smiling, often singing, or guying one another, or playing practical jokes as they tramped along, rippling from head to heel with the sheer joy of physical fitness and vigor, the glory of the flesh — they looked as if they had not a care in the world, and were ready for anything, like Landor's heroes of old Greece, "Who with a frolic welcome met the thunder and the sunshine."

The armies in France to-day (1917), including our splendidly conditioned, lean, wiry, and sunburnt boys from the Mexican border, are a triumph of

what can be accomplished by intelligent, united physical training, splendid feeding, and the most watchful and expert of sanitary care. So superbly has the combination worked that the men in the camps and in the trenches have actually, outside, of course, of battle casualties and wounds, a lower disease-rate and a far lower death-rate from disease than the armies of the respective countries have in their barracks in time of peace, and of course far below that of the average civil population. Even through the awful weather of last winter — the worst in twenty years, not merely coldest, but stormiest — when flooding rain and driving sleet and bitter frost and whirling snow alternated with one another against a background of bottomless, stinking mud right up to the middle of April, I found actually less influenza and sore throat, pneumonia and bronchitis, in the trenches than there were in Paris or London or New York.

Still more unexpected and incredible, all through one of the savagest and severest winter campaigns ever fought, under an unprecedented strain of continuous exposure to the elements in their most bitter and vicious forms, one of the longest and most grueling endurance runs to which the human automobile has ever been submitted, there was less rheumatism than in a great city hospital during the same months. In fact, the disease was astonish-

ingly rare and most of it of the so-called muscular variety.

How has this splendid and lasting physical perfection of the fighting man, this capacity to rise superior to all the strange and unexpected stresses and hardships of modern war, been brought about? Simply by that infinite capacity for taking pains which Buffon declared was genius. From the day that the new recruit first joined the colors, every detail of his clothing, his equipment, his feeding, his housing, his physical training, his protection against disease, has been taken over and watched with sleepless care, according to most carefully thought-out and tested plans.

A staff — literally an army in itself — of the ablest and most carefully selected experts in sanitation, in food-supply, in engineering, in physical training, and in medicine, has been brought together for this from all the resources of civilization. His food, the famous army ration, represents the experience of years and the labors of commission after commission, not merely of practiced campaigners, but of physiologists, food experts, chemists. Its amount, its constituents, its proportions, and its variety have been determined almost regardless of considerations of expense, simply for the purpose of supplying the human machine with the most abundant and effective and strength-supporting supply of fuel possible which is available

in sufficient amounts in the field and reasonably capable of transportation.

No college athletes' training-table serves anything better from the point of view of actual need for vigor, efficiency, and endurance than the modern army ration, particularly our own and that of England. Its only weakness, which, of course, is inherent in all army rations, is in point of variety and elasticity, so to speak, particularly in the more perishable accessory foods such as fresh vegetables, fresh fruits, eggs, milk, etc. But these in this war have been very largely made good by canteens, Y.M.C.A. "huts," with their cafés, and the judicious patronage and encouragement of "local industries." There is scarcely another diet in the land, even in the most luxurious and expensive private tables which is chosen so solely with an eye to vigor and health and with so little regard to expense in the essentials.

Every detail of the fighting man's clothing, the cut and texture of his uniform, his underwear, the quality of his socks, the shape of his shoes, is the product of generations of patient and unwearied study and experiment. Just to take one detail: The new army shoe of the United States Army is one of the most perfect and practical specimens of human footwear anywhere to be found, and the report of the commission of army surgeons headed by Major Munson,

which recommended it, is one of the ablest and most authoritative documents, in literature, upon shoes and their structure and the care and protection of the feet.

The site for his training camp is selected with the greatest care, usually upon rolling, porous ground with good natural drainage and exposure; it is carefully drained both surface and deep, supplied with perfect water and a system of sewers; in fact, many of the more favorably situated sites might be easily described without any exaggeration as military health resorts. He is housed — not merely in the training camp, but usually also in the field, on account of one of the redeeming features of trench warfare, its comparative stationariness — in comfortable wooden barracks called huts, planned for protection and warmth combined with ventilation. His washing is taken care of, either by the hard-working and competent women of the neighboring country, or in the camps and in most places on the front by great steam laundries capable of handling thousands of garments per hour which are installed at some convenient point toward the base, for each army.

He has not only the best and promptest of medical attention, but splendid hospital care if he falls sick. Every possible precaution, however, is taken to prevent the possibility of the development of disease or

exposure to infection. Each large army area has not merely its regimental doctors and hospital surgeons and physicians, but a visiting sanitary inspector, with a staff of sanitary-service men in each camp who devote their entire time to inspecting and keeping up to the mark all the sanitary arrangements of the camps.

In most camps every particle of refuse, of night soil, of garbage that cannot be utilized, is not only collected with the most scrupulous care and cleanliness, but completely destroyed by burning, which ends at once all possibility of its ever getting into the water-supply, or fouling new camp sites, or reappearing in any possible way to cause trouble in the future. All the manure from the cavalry and transport lines is either spread upon the land at once, often by the thrifty farmers of the neighborhood, or else burnt. This burning process calls for a good deal of trouble and skill, but it has another tremendous advantage in camp hygiene, that it robs our most intimate enemy and pest, the fly, of most of his hope of existence, by depriving him of both pasturage and breeding-grounds. This is supplemented by a vigorous anti-fly campaign, with the result that a large proportion of our camps on the Western Front are comparatively free from the plague of flies, which means that two thirds of the risks of diarrhoea and dysentery are wiped out at one stroke, and accounts for a

really astonishing scarcity on the Western Front of both these typical army diseases. And the head of the list in this triumph of sanitation and cleanliness is held by the Italian army camp and hospitals.

The wonderful protection against typhoid secured by vaccination is now a household word. The high feeding and good housing and ventilation, with the open-air life, give almost sanatorium conditions against tuberculosis as well as against pneumonia and bronchitis.

In fine, I have no hesitation in asserting, on the basis of a fairly extensive sanitary experience on both sides of the Atlantic, that I know very few cities in the world, even those that pride themselves on the perfection of their health departments, which are kept in as good sanitary condition, with as little disease, as are the majority of our camps on the Western Front. So that the father and mother who give their boy for the defense of his country may have at least the consolation and satisfaction of knowing that the only risks that he will run are the necessary and inseparable perils of the battle-field itself. It is hardly too much to say that nowhere in the world to-day are bodies of young men maintained under better and wholesomer hygienic — yes, and moral and intellectual — surroundings and influences than the soldiers on the battle-fronts of Western Europe. Those who survive the sad and inseparable crowning risks of

battle, death, or permanent disability, which will not exceed all told three per cent per annum, will have had a training and improving of their physique, a quickening and broadening of their intellect, which will be an endowment and valuable education for any field of future work and a permanent benefit to them through after life.

V

THE LAND OF THE HAPPY WARRIOR AND THE CHEERFUL WOUNDED

HE jests at scars who rests on a C.C.S. pillow. Of course everybody knows what a "C.C.S." is — or if they don't, they ought to, because it is about the biggest thing that has happened since the beginning of this war in the way of humanity and helpful science. "C.C.S.," in chilly, laconic, official speech, means "Casualty Clearing-Station." But to hundreds of thousands of our brave wounded, it means far more than that. To them the three magic letters stand for a little hospital heaven here upon earth, ease after agony, rest after torment, cleanness and coolness and comfort, after mud and filth and carnage, Elysium after Tophet.

A Casualty Clearing-Station is a little first-class city hospital on the pavilion plan, all complete with every modern convenience: full staff of surgeons, nurses, orderlies, X-Ray Room, Bacteriological Laboratory, hot and cold water, electric light — dropped down on the field of war within five or ten miles of the firing-line. Not so very little either, for some of them have over a thousand beds, though the average is about three or four hundred. The main

difference between it and a city hospital is that it is built of wood instead of brick or stone and that it lies alongside of a railway line. Its wards consist of long, plain but comfortable wooden buildings, some sixty feet long by twenty-odd wide, with windows every ten feet and a ventilator in the roof, called by the absurd and inadequate name of "huts." They have good wooden floors, tarred, weather-tight roofs, windows, with a "hopper" upper sash for oblique ventilation, and stoves so that they can be kept warm and dry as toast in cold or stormy weather.

Their only administrative drawback is that nurses and patients have to go out of doors each time they pass from one ward to another or from the ward to the operating-room. But this is now being overcome by grouping them together by fours in the shape of the letter "H," with the operating- and dressing-rooms as the cross-bar and connected by roofed passages.

So comfortable and efficient are these stations and so well do they serve their purpose that they raise the question, in the minds of all who have served in them, whether it is really necessary in our great city hospitals to spend the enormous sums, rising sometimes to as much as five thousand dollars per bed, on huge and majestic monuments of stone and steel and glass, when all the fundamental essentials for the care of the sick and the wounded, in plain, vernac-



A WOUNDED MAN CHEERED BY A CHAPLAIN AS HE IS BROUGHT
IN ON THE LIGHT RAILWAY, WESTERN FRONT



WOUNDED ON THE LIGHT RAILWAY, SALONICA FRONT

ular phrase, the "guts" of a hospital, are provided here in wood and tar paper for about one hundred dollars per bed? A question which our experience with sanatoria for tuberculosis has also suggested to us.

Modern war is no longer solely destructive; nearly half its energies are devoted to clothing and feeding and healing, and the central and vital knot of its work of healing, repairing, and making over again the wreckage from the firing-line is the Casualty Clearing-Station.

Into its front gate pour, converging like the sticks of a fan, the lines of ambulances bearing the wounded from a five- to fifteen-mile sector of the Front. From its back door, which opens directly upon a line or spur of railway, its clean and convalescing "graduates," when pronounced fit to travel, are "cleared" directly into the comfortable berths of the long hospital trains, which roll them down to, and distribute them among, the great base hospitals near the coast, or to the quays alongside the waiting hospital ships for "Blighty" direct.

From the moment that a man falls and is picked up by the stretcher-bearers, the superb scheme of the Royal Army Medical Service takes complete and competent charge of him. All he has to do is to press the button by getting wounded and it does the rest, and does it astoundingly, incredibly well. Our American Medical Service in France is planned and carried out

along almost exactly the same lines, though as one after another of our army surgeons who has seen the superb British system at work has exclaimed to me: "If we can only build up anything like it in five years!"

The first stage of his journey toward recovery — for of every hundred men not killed outright or dying before the bearers can bring them in, ninety recover — ends at the Regimental Aid Station, or "Poste de Secours" as the French call it, in the third-line trench or close behind it. Usually he is carried by bearers all the way to this, but in particularly well-planned trenches, where the nature of the ground and the slant of the enemy's fire permit, he goes on wheels along extra wide communicating trenches, paved so as to allow ammunition to be wheeled out in handcarts and to bring wounded back, or even laid with small trolley lines and handcarts for this double service. This is a great mercy, for though the stretcher-bearers are gentleness itself, there is an inevitable swing and joggle about this method of carriage which is agony for the grating ends of a broken bone.

If the wounded man is so badly hurt or bleeding so profusely as to make it risky to lift him, a tourniquet is put on if possible, and a runner sent back for the surgeon. This does n't take long, for, although according to the Regulations, a surgeon's place is in the

third-line trench, for good and obvious reasons, when the wounded are coming in quickly, so that they know just where to find him and where he has his table and orderlies and ether and instruments, etc., he is often found, in the beginning of an attack, well up in the second or even the front-line trenches; where he has no official business whatever, only it gives the men confidence and they like to feel that he is close at hand and in easy reach, in case of — accidents.

In an earlier day the surgeon often actually "went over the top" with the rest of the line in a charge, but the men themselves affectionately protested against this. Supposing something happened to the doctor — a dozen men might bleed to death before another surgeon could be brought up from the Dressing-Stations in the rear; and it is no longer considered good form.

In hundreds of instances, however, when "No Man's Land" begins to get populated by groaning and writhing figures, over has gone the surgeon, instruments, ether, bandages, and all, and establishing a Dressing-Station at the bottom of a shell-crater, where the wounded at least are fairly safe from everything but a direct hit of shell, has gone about his healing business under a perfect hell of fire, as calmly as if he were in his white enameled sky-lighted operating-room at home.

I saw the ribbon of one Victoria Cross on the coat of a quiet young surgeon, who after a charge had walked out with his instruments into the middle of the Zone of Death, and, dropping on his knees beside the first wounded man, had calmly worked his way down the *whole length of the regimental front* without a shred of cover or protection, taking every case as he went, both friend and foe, until the field was cleared of wounded.

There are, however, practical drawbacks to the shell-hole dressing-station, in addition to its extreme immediate riskiness. On account of the — to put it mildly — indiscriminateness of the Hun fire, you are extremely likely to have half the wounded you have so carefully operated on and patched up torn to bits by a shell or wounded afresh by rifle or machine-gun bullets, while they are being carried to the shelter of the front trench. On the whole, Tommy's judgment is sound. "Better risk a few stretcher-bearers, fetching 'em in, or if the strafing is *too* fierce, wait till dark."

But the post of Regimental Surgeon is something of a man's job and the real place of honor in this War of Life-Saving. That it is filled by real men in hundreds may be grimly glimpsed from the report that *over four hundred* surgeons were killed or wounded on the Somme alone in 1916.

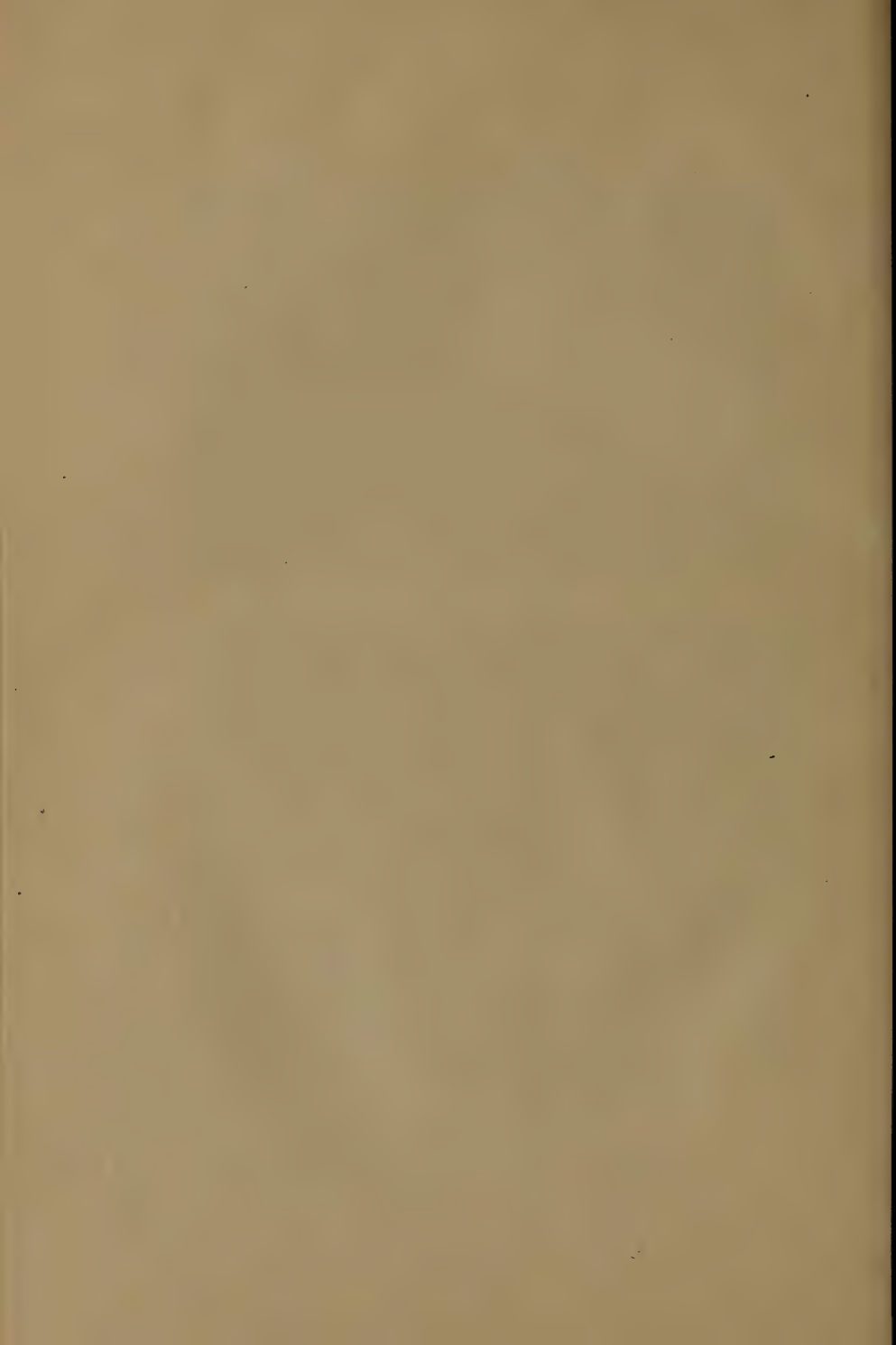
The Regimental Aid Post where our wounded man first halts — we ought to have a good single-



DRESSING A GUARDS OFFICER ON A FLANDERS BATTLE-FIELD



CANADIAN RED CROSS MEN ATTENDING TO WOUNDED GERMANS
AT AN ADVANCE DRESSING-STATION



word name for him, like the French, who say simply "un blessé," "a wounded," plural "blessés," as a dear old French surgeon-general used to translate it for me "our poor woundeds" — is usually in a dug-out, or in a vaulted hut made of heavy iron arches, set side by side and covered with earth and turf, known as "an elephant"; because nothing delights the Boche so much as nosing out one of these aid posts full of wounded and shelling it.

Here the surgeon, with his table and orderlies, cuts open the clothing and makes a rapid but careful examination of the wounds, ties up any spouting or badly oozing arteries, puts temporary splints upon any broken limbs, and dresses and binds up the wounds, for the trip to the Casualty Clearing-Station. If the wound is at all serious he gives a "shot" of tetanus anti-toxin, to ward off lockjaw, and if the pain is severe an injection of morphine. In the beginning of the war there was an alarming amount of tetanus, or lockjaw, with many deaths, among the wounded; due chiefly to the curious fact that the battles were being fought upon some of the richest and most intensively cultivated land in Europe. The soil, having been very heavily fertilized with stable manure, was simply swarming with tetanus bacilli, whose natural habitat is the intestinal canal of the horse, and these were blown deep into the wounds on fragments of shell. Thanks to the tetanus anti-

toxin, however, this deadly disease was quickly brought down to the vanishing point and has been kept there ever since, but only by dint of constant vigilance and by free use of the preventive dose. The only drawback to its use is that it consists of the serum of the blood of immunized horses, and this "foreign serum" *sensitizes* the blood in a curious way. So that if a man gets wounded a second time — and thousands of them do — and a second dose of the anti-toxin is given, he may break out into a furious itching eruption all over, like giant hives or nettle-rash. The anti-toxin itself has nothing to do with this, it is simply the horse-blood in which it is carried. Just as some people are naturally *sensitized* to strawberries, or cheese, or shell-fish, so that they "break out" and itch whenever they eat them, so the "blessé" who has been given one dose of horse's blood is sometimes sensitized against it in future. The rash fortunately is entirely harmless, but it is very disagreeable during the few days it lasts.

At the Regimental Aid Post the live express package is "tagged" and labeled for his long journey. An orderly writes down upon a colored card a few vital details, his name, regiment, place and hour of wound, nature of projectile, and the surgeon adds nature of wound, kind of dressing applied, or operation done, and whether anti-toxin or morphine has been given. Usually to be quite sure a colored cross

is marked on his forehead with an indelible pencil when the anti-toxin is injected.

This card is slipped into a large envelope of tough, translucent, waterproof paper, closed at the upper end by a string running through two eyelet-holes, which is looped round his neck or tied through the buttonhole of his coat. Each place where he is examined or handled or kept slips in another card of data, usually of a special color, with notes on his temperature, sleep, progress, etc. So that when he finally reaches either the last Base Hospital or home, the history clerk cuts the loop and takes out a complete history and clinical record of the case which he can copy into the hospital register.

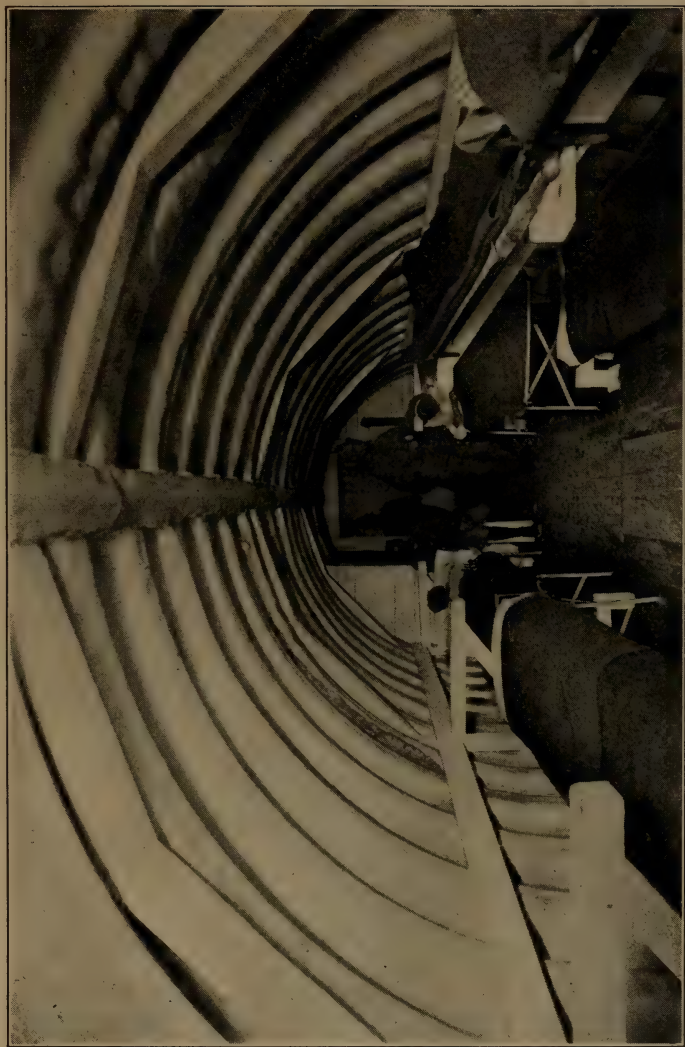
Where the roads are "unsanitary" our neatly tied up and labeled living packet may have to lie on his stretcher in the Aid Station till dark, when it is safe for the ambulance to come up, but if there is a good road he may be taken on a wheeled stretcher, which is not large enough to draw the enemy's fire, or, if a railroad track runs near by, on a hand trolley along that.

In regions near a canal a big new barge is cleaned, painted, and fitted up as a spick-and-span floating Hospital or rather Dressing-Station and Ambulance combined, and the wounded carried directly to that and floated smoothly and luxuriously down to the Base Hospital. Nothing is overlooked in this war.

The wounded's next stage will end at the Advance Dressing-Station, which used to be in a vacant building, but now is usually in a cellar, or large cavern or gallery excavated underground. One that I visited was in the extensive cellars under the prison of a now world-famous little town with a Cloth-Hall. The wisdom of its being underground was sharply demonstrated the very day I was there, for twelve bearers had been badly wounded by a shell, in the courtyard above it that morning.

Some of these Dressing-Station are quite extensive, with caverns and galleries that will accommodate four or five hundred men and a staff to correspond. One feature strikes you curiously as you go down into their mine-like entrance and that is double barriers across the passage of thick blanket curtains, about twenty feet apart. These are for protection against gas and form a sort of "air lock" so that the outer curtain barrier can be raised to allow the bearers to rush in with their burdens and dropped again behind them.

Then the air in the "lock" is sprayed with a soda solution to neutralize the poison gas, and when it is cleared the second curtain barrier is raised and the wounded carried in safely without risk of letting in any fumes. The curtains themselves are kept moistened with a soda solution, for, by the mercy of Heaven, when the deadly strangling chlorine gas



IN A FRENCH UNDERGROUND DRESSING-STATION

comes in contact with moist soda, it is promptly transformed into harmless common salt or chloride of sodium. This is roughly the principle of the famous gas-masks.

Some of these great cave-hospitals have apparatus for chemically purifying the air of fumes and pumping it in to supply their occupants all through the thickest gas clouds.

The main danger against which these precautions are taken is gas-shells, shells which when they explode belch out thick clouds of poisonous gas instead of shrapnel bullets. This gas is heavier than air and pours down any mine or cave openings like so much water. If Fritz can only spot, through his airmen, the opening of a cave hospital and spatter it with gas-shells he's happy for a week. The idea of strangling the wretched wounded in their cots underground appeals strongly to his sense of humor.

So constant is this gas danger that in the French Dressing-Stations and Field Hospitals, every occupied bed is obliged to keep a gas-mask hanging in its case on the wall close to its head, day and night.

In the underground Dressing-Stations the patient is given a quick, skillful looking-over, to see if his wound is bleeding again, or his dressings have shifted in any way, and if he has bled heavily or is severely shocked, he may be given stimulants and warming drinks and kept for the night; or if an immediate

operation is urgently demanded, it may be done here.

Some cases stand traveling very badly, like wounds of the brain or of the abdomen, and these may be kept and carefully tended here, for a week or more; but the vast majority get merely a swift looking-over and such operating as is immediately necessary, and as soon as darkness comes or the roads are free from shell fire, they are lifted into the ambulance again and rolled back toward the Hospital.

On their way they usually pass through another way-station, known as the Field Ambulance. The word "ambulance," in military parlance, means three distinct and different things: First, the whole service and means of handling the wounded from the trenches back to the Casualty Clearing-Station. An Ambulance in this sense may consist of forty or fifty vehicles, ten or fifteen doctors, and one hundred orderlies and stretcher-bearers. Second, a Field Hospital of from fifty to one hundred beds, usually in tents between the Dressing-Station and the C.C.S. Third, the *real* ambulance or vehicle itself. A motor, often of a well-known, affectionately jeered at, inexpensive American make, fitted with a high van-body, with bunk-like folding racks for stretchers on each wall, enabling it to carry four "liers" or eight "sitters" ("couchés" and "à pieds," as the French say); incidentally one of the greatest minor boons to

the safe collection and comfort of the wounded which Heaven has vouchsafed in this war.

Here our pilgrim gets another swift, searching expert "once over" to see that nothing is going wrong, and within a score or two of minutes more he is rolling smoothly down the well-paved military road, and circling up to the receiving door of the Casualty Clearing-Station.

Here he is met by the surgeon on duty, with his orderlies and nurses, who, with the quickness born of much practice, run over his history cards, deftly remove his clothing and undo or expose the dressings. From the appearance of these together with the history, the surgeon promptly decides whether any operation is likely to be necessary or not. If not, he is borne swiftly off to the cleaning-up room of a ward, where the mud of the trenches is scraped off of him, and the blood washed out of his hair and finger-nails, and his whole body sponged and cleaned and alcohol-rubbed. A bowl of hot soup or fragrant tea is given him, and finally, cleaned and combed and resplendent in a gayly striped new suit of pajamas, he sinks with a sigh into the first clean soft bed with real sheets on it he has been in for months and enters upon the delightful adventure of getting well, with the chances thirty to one in his favor.

If the wounded requires an operation, he is carried at once to the preparation-room of the operating-

theater. A very large majority do require an operation in these days of shell-fire wounds when no one knows how many splinters of shell may be buried in the flesh; when every corner of the wound is packed with germs from the soil, and the tissues not merely torn and cut, but parts of them so pulped and shattered that they must be cut and cleared away in order to allow the wound to come together and heal properly. In this preparation-room, he is swiftly undressed and washed and made as nearly aseptic as possible, the anæsthetic for the operation being given first, if the wounds are extensive and painful. Then the surgeon on duty carefully probes the wound with a gloved finger or sterilized forceps and gauges the extent of the injury and whether nerves, great blood vessels or joints are involved.

If the case is an "average" one the surgeon proceeds with the operation himself at once, but if it presents special features of difficulty or interest, he turns it over to the surgical specialist on the staff in whose province it belongs. For the staff of a Casualty Clearing-Station, while young and keen, are not merely fully qualified surgeons with from one to five years' hospital experience, but at least half of them have been specially trained in the surgery of some particular region. One, for instance, will have had special experience in surgery of the brain and spinal cord; another, of the abdomen; another, of the nerves;

and another, of the joints. Many of the older ones had established reputations in their chosen field, before the war; others, the younger, have been carefully trained on the dreadfully abundant material since the outbreak in the great Base and Home Hospitals. They are a splendid body of men, with the fire and enthusiasm and progressiveness of youth, tempered by the experience and caution of age, and they all work together like one man for one object — the best interests of the wounded and the increase of surgical knowledge and skill.

Each has his group of trained assistants and operation nurses, and so superbly are they organized, and so splendid their "team-work," that it is no unusual thing for a staff of ten or twelve, working triple shifts, — that is, six hours operating, three hours rest, and repeat till finished, — to take care of four hundred, five hundred, even seven hundred patients in twenty-four hours. Indeed, one mammoth field hospital that I visited, with a staff of sixteen surgeons and their squads, had actually dealt with fourteen hundred patients in the preceding thirty-six hours! One of the surgeons told me that he had been in the operating-room from two o'clock one morning till six the next with only four hours' sleep, but he was going to sleep for a week now, to catch up.

Lest anything should possibly be overlooked and the patient fail to get the utmost benefit of all the skill

and knowledge in possession of the medical profession, these Casualty Clearing-Stations and all other Military Hospitals are provided with a staff of consultants. Men whose names are household words in the medical profession, not merely of England, but of America and all over Europe, who have abandoned huge and princely practices and for the mere pittance of an Army officer's pay, travel incessantly, up and down the whole zone of the armies, visiting every place where wounded are cared for, from the smallest Advance Dressing-Station to the hugest Base Hospital, advising, encouraging, assisting; placing all their skill and their fame and their experience at the service of the injured.

If there is anything puzzling or unusual, or specially serious and grave, or a delicate question as to the nature of the operation to be performed, all that is necessary is to send a telephone message on to the "D.D.M.S." (Director of Medical Service of the District), and one of these consultants will arrive at the Hospital next morning, or within a few hours, if the case be urgent.

The superb hospital trains deserve a chapter to themselves. Arranged like Pullmans with permanent berths along both sides vestibuled together they carry from one to two hundred "cot" cases and twice as many "sitters." They have complete kitchens and staffs, dressing-rooms, small operating room for emer-

gencies, full staff of doctors and nurses and provisions and supplies for three days. In drives ordinary passenger cars are hastily transformed, seats turned into bunks, baggage or even box cars into kitchens and dressing-rooms. But all carry the wounded in comfort and perfect safety and the newer de luxe hospital in trains in positive luxury.

To describe the perfection of the nursing service and general management of the Clearing-Stations and Field Hospitals would be a sheer waste of words. Every one who has visited a ward in a War Hospital, or who has had letters from a wounded member of his family, knows all about them, with their spotless linen, their bright-colored blankets and mattings, their flowers and their pictures. Everywhere woman has been permitted to go in this war she has made a little paradise of comfort and helpfulness.

When it comes to the nurses themselves — trained or volunteer, Red Cross or V.A.D., their skill, their unwearied devotion, their courage and self-sacrifice, one can only paraphrase the old Hindoo saying, "God could n't be everywhere, so he made nurses."

In fine, the net result is that every wounded man on the Western Front, from the private to the general, receives unfailingly treatment and care which for effectiveness, perfection in every detail, and pitch of professional skill a millionaire might envy, and than which not all his wealth could purchase any

better. It is really difficult to imagine anything finer.

Its results in cold, passionless figures speak for themselves. Of those surviving twenty-four hours, ninety per cent recover; of those reaching the Clearing-Stations, ninety-five per cent get well; and there are many Base Hospitals which have "graduated" tens of thousands of cases with less than one per cent of deaths! No wonder the wounded look cheerful!

Their names are not so frequently mentioned in the dispatches as those of the commanders of the Line, but the Nation will never forget its debt of gratitude to the men whose skill and superb ability and devotion have organized and directed this magnificent service of life-saving;—Sir Alfred Keogh in England, and Sir Arthur Sloggett and General McPherson in France, with their devoted staffs and surgeons of the Royal Army Medical Corps, and in our American Army General Gorgas in Washington and General Ireland in France.

VI

A DAY IN A FRENCH FIELD HOSPITAL

THIS is a war of initials and nicknames. Its greatest and most beloved General is "Papa Joffre," its most terrible explosive "T.N.T."; its favorite piece of artillery, the "Soixante-quinze" or "75" millimetres (bore 3 inches); the fine fighting men from the Colonies rejoice in the title of "Anzacs"; and our own American soldier boys have been christened "Amex."²

The Front itself fairly bristles with initials, and your guide-posts at every corner are white boards bearing bewildering arrangements of large black capital letters, some of which it would require the ingenuity of a Sherlock Holmes to interpret, though to the initiated they are as plain as print.

If you are bent on errands or matters medical you should keep a sharp lookout for a sign with an "M" on it, either "D.M.S." (Director of Medical Service) or "S.S.M." (Service de Santé Militaire), according to the army you happen to be in. Only don't let another rather frequent sign with an "M" in it mislead you, for "A.P.M." (Assistant Provost Marshal) or "Police Militaire" will land you in the office of the Military Policeman, a very stern and dangerous

person, indeed, with an insatiable thirst for prying into your private life and the dates and visés on your passes.

So that when our chauffeur caught sight, through the dust of a crowded and teeming roadway, not many miles behind a rather lively section of the French Front, of a large board with the inscription in huge black letters, "H.O.E. No. 121," — this is not the real number or the censors would not have let it pass, — he knew that we had reached our destination, and swung into the entrance way underneath it.

These letters meant nothing, however, to my benighted eye, and after puzzling over them for some minutes, I followed my usual procedure and asked the courteous Surgeon Inspector of the Army, who was accompanying me, what they stood for. "Oh," he said, "'H.O.' is for hospital and 'E' for 'evacuation,' and we call it 'Ashooway.'" And since a Frenchman actually does not know when he is or is not pronouncing an "h," it frequently comes out "Hashooway." In English it becomes "C.C.S." or Casualty Clearing-Station, and in our Army "Evacuation Hospital."

Under whatever name it goes, however, it is a most useful and important institution in all three armies, and, curiously enough, is quite outgrowing its rather singular name. Beginning as a small canvas-covered affair, with only a few dozen beds, where the

wounded could be cared for overnight, or for a few days until they could be "cleared" or "evacuated" into the hospital trains or wagon convoys for transportation to the base, it has now grown into one of the most important hospital centers of the war. This was due partly to the comparative fixity of the Front which gave plenty of time to build railroads and bring hospital equipments and supplies close up to the firing-line; partly to the blessed boon of the motor ambulance, which can carry a wounded man on average roads ten miles, on good ones thirty, more easily than stretcher-bearers could one. As a consequence, a regular line of these houses of mercy has sprung up parallel with and from seven to ten miles behind the firing-line.

The tents have been replaced by comfortable wooden wards. The operating-rooms are as perfectly equipped and splendidly managed as in a high-class city hospital. An X-Ray Room, a Bacteriological Laboratory, bathrooms with hot and cold water, electric lights, have been added and the two or three dozen cots have expanded to three hundred, six hundred, fifteen hundred beds, with a full staff of expert surgeons and, best of all, of trained women nurses.

The one which we had come to visit was an unusually large one, containing nearly two thousand beds, and stretching its thirty-odd long wooden buildings along a ridge or shelf on the side of a beautiful val-

ley just above a little river. Its "streets" converged toward, or ran parallel with, the double-tracked railroad siding with high platforms from which the wounded could be lifted or wheeled directly into the waiting hospital train.

At one end were the cook-houses and kitchens. At the other the Officers' Mess and the Nurses' Quarters. On the lower side, toward the river, were the disinfection and laundry and waste-disposal plants, while big double water-tanks — one for the chlorination and the other for the storage of the water-supply — towered up in the center of the camp.

The situation was a charming one: on one side of the valley, behind the camp, the ground rose quite abruptly until it reached a high, rounded hill, crowned with a quaint old stone-walled, gray-roofed village and topped by a great rough-hewn, thick-walled church — half cathedral, half fortress in appearance, which was a landmark for thirty miles.

In front, on the other side of the river, the ground rose more gradually for a mile or two, then began to climb rapidly, and finally terminated in the blue wooded crest, clear-cut along the horizon, of a very famous and much fought-over Ridge, the *Chemin des Dames*.

We climbed next day up to the fortress-like church, and found that nearly a third of its massive eight-foot walls had actually belonged to an ancient cathe-

dral which the curé proudly assured us was a famous holy place before Rheims was ever thought of. Indeed, according to him, while the early French kings used to hold their show coronations in the upstart parvenu cathedral at Rheims they always used to come up here afterwards for a second ceremony to make sure that the crown was properly blessed on, so that it would stick.

We were first shown a general plan of the hospital by the surgeon commanding, and then taken through it from the beginning — the point where the field ambulances swung up to the platform and delivered their burdens.

First of all, the wounded man, or “blessé” is carried into the first of the so-called “Salles de Triage” or sorting wards. Here his name and regimental number, and if he is in condition to give it, the address of his family, are taken; his side arms and cartridge-belt are taken off and stored away, and his kit-bag and personal belongings and any money or other articles of value are tied up in a neat canvas bag, and deposited in racks until he needs them in the wards or is ready to be sent on from the hospital. Then a hasty look-over from the surgeon sends him into one of the two other “Salles de Triage” — that of the “Petits Blessés” if he is only slightly wounded and that of the “Grands Blessés” if he is more severely so.

In the "petits blessés" division, there is a dressing-room with junior surgeon and staff; and the dressings already applied at the "Poste de Secours" or Field Ambulances are examined and replaced if necessary; then if the wounds are light, the "blessé" is sent into the huts or tents which form a sort of rest-camp, which is not under full hospital discipline, but where he is very well taken care of until, after a week or ten days, he is fit to go back again to the firing-line. To the same place are sent the men who have suffered slight accidents or strains, or whose digestion has given way, or who are out of sorts generally, without any fever or serious illness, but who would probably develop something more serious if they were not given a little rest and special care and feeding. These so-called rest-camps or "éclopés" huts have been found extremely useful in this war, as a means of relieving and quickly building up again men, particularly of the older classes, who seem to be getting, in the expressive parlance of the street, "under the weather" or "off their feed" under the strain of trench life. A week of rest and comfort, with hot baths and massage and some extra delicacies in the way of food, often does wonders for them and sends them back feeling quite fit again.

It was considered a rather quiet section of the Front at that time — though it has wakened up with vengeance since — but there was a steady trickle of

wounded men into the hospital, ranging from fifty to one hundred cases a day. Three motor ambulances had just rolled up with their load, so that when we entered the third "Salle de Triage," we found eight or ten silent figures resting on their stretchers, waiting to be carried into the cleaning-up room for operation.

I say "silent" advisedly, for one of the most unexpected things, in this war of surprises, is the almost utter absence of any sounds of pain or outcry of any description from the wounded. I have seen wounded men literally in tens of thousands from within a few minutes of the time they were hit, through the various stages of dressings and operations, right back to the Base Hospital, and almost the only sound that I have heard out of their lips was that of cheerful and often joking conversation with their stretcher-bearers, their doctors, or their fellow "blessés."

Walk through the wards of a Military Hospital, whether a front-line ambulance, "Ashooway," or Base, and you hear no more cries of pain than you would, say, in the surgical ward of an ordinary city hospital. Of course, there are exceptions, but they are scarcely one in thirty.

Men with a badly shattered fracture, particularly of the thigh, men with severe shell wound of the abdomen, have a pretty uncomfortable time of it for the first few days, and can't help groaning or even

crying out in the night at times. Sometimes, too, a man who has been badly hit or lost a good deal of blood, or stunned so that his nerves are severely shaken, will whimper, half under his breath, in a curious sort of way, like a lost child waking suddenly in the night, and unable to make out where he is or what has happened to him. But this usually soon passes off when they have been made warm and comfortable, and given hot soup and stimulants, so that their jangled nerves are brought back into tune again.

Part of this cheerful quietness is due to sheer pluck and a brave determination to put the best face on the matter and encourage others. But part of it is due to purely physical factors. Most mercifully the one redeeming feature about the terrible shell wounds of this war is that they are not nearly so painful as a wound from the old-fashioned, slower-moving projectiles. They strike with such lightning-like speed and tremendous force, that they seem to crush and shatter and stun the nerves in their path into numbness, which sometimes lasts for several days. Indeed, this is no mere figure of speech, for one of the most serious difficulties in restoring movement and strength to badly broken or shattered limbs, after the wounds are healed, is the distressing frequency with which important nerves or nerve-trunks of considerable size have been cut or torn across, leaving the muscles below them paralyzed.



LADY LORRY-DRIVERS



A CHEERFUL WOUNDED CANADIAN OFFICER BOARDING A
HOSPITAL TRAIN



The other factor is that the greatest pain and most prolonged agony of wounds is due to inflammation with suppuration and abscess formation, and these for the most part, in spite of the soil infections carried in on fragments of shell, modern surgery has been able to prevent; or, at least, by its methods of continuous flushing and cleansing and keeping open of the wounds, has avoided any blocking up with consequent rise of pressure, heat, and throbbing pain.

Many of the men, in fact, express surprise that they should be laid up so completely by wounds which hurt them so little except when dressed or moved in some way. Often when quite badly wounded, they will declare that they did not know they were hit until one of their legs suddenly gave way under them, or their rifle dropped out of their hands, and for several seconds were quite puzzled to know what had happened to them.

Surgeons, on the other hand, assured me that if they could secure a steady and abundant supply of laughing-gas, or nitrous-oxide, such as is used in dental operations, they would be able to perform a great many operations under that alone, because the tissues about the wound are so numbed that if the patient's brain, so to speak, can be numbed and put to sleep for a few minutes, the operation will be practically over before he regains consciousness. But

as both laughing-gas and the oxygen which has to be given with it can be carried only in large heavy iron tanks or containers, which are very inconvenient to transport, this method is not generally practicable in the front-line operating-rooms.

From the "Salle" of the "Grands Blessés," the wounded man is carried into the cleaning-up room, which does not sound very romantic, but is one of the most indispensable portals of the military temple of healing. Here his soiled and blood-soaked clothes are removed, the mud of the trenches is scrapped and scrubbed and sluiced off him with warm water and alcohol, he is thoroughly insect-powdered, and put into clean bed garments. Then the skilled bearers of the operating squad lift him up gently and carry him into the etherization room, where, after a few pungent, aromatic, half-strangling breaths, he knows no more until he wakes to find himself in a clean, soft, comfortable bed, with hot-water bottles round him, a vision in white ready to meet his every want, and a thirty to one chance of rapid recovery. Whichever ward of the "H.O.E." or "C.C.S." he awakes in, it will be much the same — long, light, clean, cozy, with a row of cots down each side and tables, usually decorated with flowers, down the center. The only difference between the wards is that usually each one has its distinctive tint of bright-colored counterpanes, or white counterpanes

with a bright-colored blanket folded across the foot of each.

As you enter the door of the "baraque" ward, you notice, especially upon your first dozen or so visits, one striking characteristic of all these war hospitals, and that is the astonishingly healthy, rosy, bright-eyed vigorous look of the patients. They were literally in the pink of condition when they were hit; a few hours', or at most a couple of nights' good rest is abundant for their vigorous constitutions to make good whatever amount of blood they have lost. Their wounds, after they have been skillfully operated on and dressed, pain them comparatively little, and except for being wound up in dressings or mummified by splints, they look as if there was nothing whatever to prevent their getting right up and walking out of the ward, and they are as ready for jokes or hilarious repartee as so many healthy, happy school-boys.

They have an excellent appetite, a keen enjoyment of a smoke, a lively interest in the news of the day, and literally devour novels and other light literature, by the dozen and hundred.

My surgeon friends tell me that they will bring their novels with them into the dressing-room, lay them face downward on the nearest table while their wound is being dressed, and pick them up and plunge into them again the moment that the last bandage

is in place and they are lifted and carried back to the ward.

So quickly, in fact, does one come to expect this air of health and cheerfulness, as a matter of course, that one is positively struck by the exceptions. In one of the wards of this very hospital, I was walking down the center with the surgeon and head nurse, when my eye was suddenly caught by a sallow, languid, wearied-looking face, against a white pillow. So astonished was I that I instinctively and unconsciously stopped and the question leaped involuntarily to my lips, "Why, what's the matter with that man? He must be sick!" "Oh," said the surgeon, "he's just back from Salonica, and the wound has waked up his malaria again."

VII

THE RISKS OF A RED CROSS NURSE

CLEAN and cozy and comfortable as were the wards of this great French Field Hospital, at M—— they were only a fair sample of those which are to be found all along behind the four hundred-odd mile battle-line of the Western Front, wherever it is considered safe and proper to have women nurses. There was a little attitude of conservatism, of reserve, in the minds of the French Military Authorities on this question at the beginning of the war: a little survival, perhaps, of the attitude revealed in the half-alarmed, half-exasperated, most ungallant old-bachelor ejaculation, attributed to Lord Kitchener during the Boer War, "The Lord deliver us from the plague of women." Partly a feeling that it was against all the traditions and perhaps not quite proper for wounded men to be nursed by women in Field Hospitals under war conditions, and the demands that these involved. Partly a fear that women would not be satisfied with the primitive accommodations and plain diet of the campaigner.

Deeper yet, though not perhaps so freely expressed from reasons of politeness, was the belief that, being the weaker and more timorous sex, they would be-

come unnerved and panicky under the conditions and threatenings of danger which are inseparable from hospitals in the field.

But all these doubts and fears have been grandly swept away and women have shown triumphantly in this war, as in every other when they have been given the opportunity, that their place is wherever suffering is; that if there be any place which is not fit for a woman to live and work in, let her in and she will make it so.

She has won her way into and proved her priceless value in one line of Field Hospitals after another, wherever wounded men are kept and tended, right up to the Field Ambulances themselves, and the progressive surgeons are urging her admission into some of the more stationary even of these.

You can tell in an instant, just by looking in at the door of a Field Hospital ward, whether there are women nurses or not. Even if your eyes did not inform you, your nose would. I have seen a good many Hospitals and Ambulance wards, where on account of danger or remoteness or some other reason, the wounded were being cared for only by men; and while they were well looked after, their wounds well tended, given plenty to eat, and their beds kept ship-shape in a good "farmhand" sort of fashion, yet there was not anything approaching that beautiful finish of neatness and tidiness, and what was more signi-



A V.A.D. AT WORK IN FRANCE

ficant that clean, blissful, comforted expression upon the faces of the patients that one sees in wards where women nurses rule.

No mere man will ever keep floors really clean, and beds white-sheeted and tidy, and windows hung with white curtains, except occasionally under severe naval discipline on shipboard, to say nothing of the score of slight but vital trifles which go to make up all the difference between a bunk-house and a cozy, comfortable, homelike ward.

Of course, it is possible to overdo it and make the men uncomfortably clean. In one beautifully kept ward, some of the Italian wounded privately and most apologetically explained to a sympathetic visitor, that while the lady nurses were angels and they could never say too much of their devotion and their kindness, yet they did think they were wasting much good water in washing and bathing them so carefully every day. Lying in such a spotless bed in such a beautifully clean room, how could they grow dirty after they had been once well washed and bathed in the beginning? But usually they fairly revel in all the attention that is given them, although they would be perfectly contented with much less exalted and exacting standards.

As for the hardships of campaign life, the nurses will take the plain board-walled shack assigned to them for quarters, and with little more than pic-

tures from the illustrated papers on the walls and flowers from the neighboring fields and gardens, a few strips of cheap matting on the floor and the hundred and one little feminine things and belongings that no true woman can be separated from, and which mysteriously find themselves wherever she goes, turn it into a cheerful, homelike, attractive bungalow.

With dainty tea-service and the ever-available jams and preserves and tins of biscuits, with all the tribe of potted and canned goods, they can embroider and work wonders with the plain and substantial mess ration from the cook-house, and transform it into a dinner with courses.

Our party was invited to afternoon tea in the nurses' quarters of this H.O.E., where we found a group of charming, white-uniformed, cultured, intelligent women, French, English, and American, serving tea upon plain board tables surrounded by camp chairs, in a room whose bare board walls had been transformed into a cozy and tasteful summer cottage. And the tea, with thin buttered slices of war bread and biscuits and cakes and sandwiches from the inexhaustible resources of the brood of tins, was as excellent and varied and appetizing as if it had been served on a wicker table in a shady English garden.

As for the steadiness of feminine nerves under trying circumstances, we happened to find an excel-

lent illustration in that very Hospital. We had n't gone far on our rounds through the wards, before my ear caught a curious, rather musical, prolonged whistling sound. At first I thought it was something blowing off from one of the numerous dynamo trucks, which were stationed here and there through the hospital, to supply electric light, hot water, or current for the X-Ray Room. But the third or fourth time that I heard it, I discovered that it seemed to be passing through the air, directly over our heads. Half suspecting the truth, I asked the lady superintendent, who was accompanying us, what it was. "Oh," she said, "that's just shells; they often do that. There's a rail-head about three quarters of a mile behind us, and the Germans shell it regularly whenever they happen to think that there is any concentration of troops taking place there." "Well, but," I suggested, "some of the shells might get tired — spent, I believe is the proper technical term — and fall short of the rail-head, somewhere in this neighborhood." "Oh, yes," she said again; "they do, but not very often. One fell right in the middle of the camp, a few days ago; smashed through the roof of a small 'baraque,' but fortunately there was no one in it at the time, and it did not explode. A number have dropped round the edges of the Hospital camp. If you listen a few minutes you will probably hear one of them beginning to clatter instead

of whine, which means that it is getting pretty nearly spent."

So I listened, and sure enough, before very long, there came a rushing, whizzing sound, which suddenly changed to a *cluttery, clattery, clack*, right over our heads, like a boy drawing a stick along a picket fence. "There," said the Sister, "is a spent one now." When we got to the upper end of the Hospital grounds, she led us to a little viewpoint from which we could look over toward the rail-head and see the strange birds that were whistling over our heads strike and turn, with a dull, sudden roar, into a great burst of thick brown smoke and showers of dirt. That tenor chorus, with the bass refrain, kept up at five or ten minutes' intervals steadily all through the afternoon, and only died away at that peaceful hour when almost everything stops, even on the battle-front — a couple of hours before sundown.

"Well," I said to the Sister, "I suppose you will have a rest now, until the whistle blows for it to begin in the morning?" "Oh, no, the aeroplane bombs at night are far the worst." And of this, also, we were fated to have actual demonstration. We still had another hospital to inspect, just on the edge of the village, below the church, and the staff most hospitably urged us to stay the night. But our inspector had an important consultation engagement that evening, twenty miles away, and so we motored over

and slept there. When we came back in the morning, we found everything in a state of suppressed excitement. Four bombs had been dropped in the night by a cruising aeroplane, right between two of the "baraque" wards. One of them fortunately was empty and it was the worst hit, torn and riddled and shattered in every direction by the fragments of shell; but in the other, two patients were killed and five or six wounded, among the latter, a nurse. What particularly interested us personally was that this empty ward which had been so badly riddled was probably *the place where we should have been put to sleep* if we had accepted the invitation and spent the night there!

Later I learned that the bombing at night had become so constant and so serious that the hospital had to be cleared of its wounded and temporarily abandoned. As it had forty-odd buildings and nearly two thousand beds, there could have been no possible mistake as to its character.

VIII

GAS-GANGRENE AND TETANUS.

THE goodness or badness of a thing depends entirely upon its surroundings, where it finds itself, as the French say. We have heard much from time immemorial of the healthfulness of close contact with Mother Earth, of getting back to and in close touch with her fertile and sustaining surface, her soft brown lap.

From its abundance comes all our sustenance, from labor in its brown furrows comes half our health; nay, we are officially informed that out of its dust our own bodily frames were originally made. But that was a very, very long time ago, and to-day to mix any more of the dust of the earth into our bodies, whether into our lungs or into our blood, is anything but a health-giving affair.

It is all very well for us to get right down and delve into the soil, but when the soil begins to delve into us, it is another matter. Dust of the earth, in the lungs to-day, spells tuberculosis; dust in the stomach means typhoid; dust in the blood, gas-gangrene and tetanus.

Of course, these troubles do not spring from the actual substance of the earth itself, in one sense, —

the sand or the clay out of which it is made. But in another sense they spring from the soil itself; that is, from elements which are an essential part of the soil, which in fact make the surface of the earth into soil, and without which there would be no life whatever possible upon the face of the earth, only a barren stretch of desert sand and sun-baked clays—the bacteria of the soil.

The soil, in fact, is alive, not dead, and bacteria are the life of it. Broadly speaking, the fertility of the soil depends upon the number of bacteria in it, and all our laborious and elaborate methods of cultivation both age-old and modern, ploughing and harrowing, disking and dynamiting, draining and irrigating, are simply to enable more billions of bacteria to flourish in a given soil.

Consequently the richer and more superbly cultivated the soil is, the more literally alive and swarming it is with bacteria, and indeed in market-garden soil, for instance, the bodies of the bacteria, infinitesimally tiny as they are, form in the mass actually as much as ten per cent of its bulk. Most of these bacteria of the soil, if they happen to get into the blood or into the body, either die at once or produce only putrefactive changes in the food in our intestines, because they cannot “eat” or grow upon living tissues.

Only one, the typhoid bacillus, has learned the trick of living in the intestines; one more, the germ

of tuberculosis, the trick of nesting in the lungs; and only two, the tetanus germ and the gas-bacillus, that of living under certain conditions in wounds.

Against the tetanus bacillus we have an effective weapon, a certain shield in the form of the tetanus anti-toxin. By the mercy of Heaven, the tetanus germ is extremely slow in starting to grow in a wound, so that if a dose of the anti-toxin is injected into the blood, within one or even two days after the wound, though preferably within a few hours, it protects the body against its invasion.

Against the gas-bacillus we had no such direct remedy, so a new line of defense has had to be worked out. This germ, under ordinary circumstances and conditions, attracts very little attention from surgeons or from human beings. He is a peaceful and blameless agriculturist living in and on the soil, attacking and breaking up the decaying animal and vegetable matters contained in it, and preparing them for absorption by the roots of the plants, while at the same time getting his own living "on the side."

In the course of this beneficent process, the bacillus produces a considerable amount of gas, as indeed is a quite common habit of many of the bacilli, illustrated by the frothing and bubbling which takes place in the ordinary processes of fermentation, in canned fruit, wine, beer, bread-raising by yeast, etc.

This gas in the soil is perfectly harmless, indeed

probably rather beneficial than otherwise, by increasing its porousness and assisting the growth of other bacteria. But when it gets into the human body and begins to liberate it in the tissues, then some very distressing effects are produced, and it is this fact which has given to it its name — now all too familiar.

When a group of these gas-producing bacteria in the soil are blown on a piece of shell deep into the human body they find themselves in clover. The fragments of the tissues which have been torn and crushed and mangled out of all vitality by the shells furnish dead animal matter for them to grow upon. They are deeply enough buried to be freed from the thing they hate most — the oxygen of the air; and the warmth of the body “forces” them like a hot-house. The result is that after about forty-eight hours, the edges of the wound begin to swell up and turn outward or backward, making it open. The discharge from the wound almost stops, and its cut surface takes on a curious half-jellified, half-mummified sort of look; then the whole wounded limb begins to swell up and distend in the most extraordinary fashion, turning, as it does so, first an ashy white and then a greenish color.

This is because the tissues are being literally blown out with the gas, and on pressing the finger down on this balloon-like swelling, a distinct crackling or tiny

bubbling sensation can be felt. The gas and the swelling extend on up over the surface of the body, bloating it, and distorting its shape; the patient begins to complain, not so much of pain as of a sense of great restlessness and depression and dread of what is coming next. His face is white and pinched, his lips bluish, his eyes widely distended and "all pupil," his temperature, instead of rising, goes steadily down, down, and unless something can be done to stop the terrible march death ends the scene within forty-eight hours, sometimes within twenty-four of the first appearance of gas in the tissues.

Small wonder that both surgeons and wounded stood aghast at such a swift and deadly process of destruction when it first began to show its horrid front in our spotless and speckless war hospitals on the Western Front as it did in thousands in the early days of the war. Our last experience with anything resembling it had been with the dreaded hospital gangrene of our American Civil War.

This was probably a mixed infection, a gas-bacillus combined with a pus germ, *Streptococcus* or *Staphylococcus*, though we shall never know with certainty because it was before the days of Lister and Pasteur, and germs had then not been "invented." Its progress was somewhat slower, but it was furiously contagious, so that it would run through whole wards, and every case coming into an infected hospital,

even though suffering from the merest scratch, would catch it and have a desperate fight for his life. As nearly half of those attacked by it died, it was one of the most terrific scourges known to the history of surgery; and when its infection once got into a hospital, that hospital had to be emptied and closed and the patients turned out into tents.

This present gas-gangrene never became a tenth as bad as that, for it had just one redeeming feature, and that is it is not actively contagious or inclined to spread; which was probably because modern surgical precautions were able to bar out the pus-forming germs and prevent them from forming that "wicked partnership" with the gas-bacillus which gave its infection wings, so to speak.

As we have only just recently developed an anti-toxin, for three years of struggle and experiment we were driven to hunt for other weapons. The first hold which we got on the germs came from the fact that they are what are known as "anerobic"; that is to say, can live without air, and not only that, but are killed by, or grow very slowly in, the presence of air and oxygen. This being the case it was quite evident that our modern aseptic method of closing and sewing up all wounds tightly at the earliest possible moment, was exactly in the wrong direction, and indeed was giving the bacillus the very thing that he most wanted, airlessness and warmth. Consequently

it became the rule to leave all shell wounds of any considerable depth, or of pocketed, irregular shape, or with mouths much smaller than their deeper parts, as wide open as possible for the first three to five days. This at once diminished the number of our cases of gas-gangrene.

The next step was the discovery that, as the bacillus could not eat, or live upon living tissue, if we could manage to clean and cut away and scrape out of the wound the crushed and shattered fragments of flesh whose vitality was destroyed, we should deprive him of any food to live upon or material to grow on.

When this was thoroughly done, within four or five, or in circumstances where it was necessary, within thirty-six, hours of the receiving of the wound, our cases of gas-gangrene took another and much heavier drop. In fact, these two methods of "ventilation" and thorough cleaning brought them down to scarcely one tenth of their former prevalence.

Finally, it was found that while the gas-bacillus, when looked for by microscopic methods, would be found in two thirds or even three fourths of all the wounds of a given hospital, and that many of the cases had not been for various reasons able to be given thorough cleaning-out of the wounds, yet the vast majority of them all would escape any real gas-infection. And, what was the important point, most of those who did develop even a moderate degree of

gas-gangrene were cases in which some other cause of depression was at work — they had had severe hemorrhages and lost a lot of blood, or they had fallen in No Man's Land, or in a shell crater in the middle of a great battle and had to lie out in the mud and rain or snow for six, eight, twenty, or even thirty-six hours before they could be brought in and attended to; or they had been ill or in bad condition from some cause before they were wounded.

In short, all conditions which tended to lower the vitality of the wounded man, or which lowered the vitality of the tissues in his wound by lack of timely and prompt attention, increased the probability of a gas-infection. The first and second of these preventive steps, namely, the thorough cleaning-out of all dead or dying tissues in the wound, technically known as "débridement," are steps in the now famous and magnificently successful Carrel treatment, and wherever that is introduced gas-gangrene sinks almost to the vanishing point, though unfortunately not quite.

Furthermore, as the Medical Service on both the French and English Fronts has become more perfectly organized, and particularly as spur lines of railroad and trolley lines have been used for the transportation of the wounded, these distressing delays have become much less common, except when the system is swamped by tens of thousands of wounded

in a few days from some great battle, and cases of gas-gangrene have gone down in like proportion.

Even before we had any anti-toxin defense against gas-gangrene, we had brought it down to a really encouragingly low figure. For instance, I spent three full weeks on the Western Fronts, in the early spring of 1917, visiting new hospitals every day and seeing tens of thousands of wounded, and in every hospital that I entered one of my first questions was: Have you any typical cases of well-marked gas-gangrene? Only once was it answered in the affirmative, and that in the last hospital but one that I visited and when I was in despair of ever seeing a case.

There were a number of cases in which there was some slight puffing and glazing of the wound, but upon promptly applying the principle of "letting in the light" — or rather air — by slitting open the tissues freely in all directions around the wound, and putting in Carrel tubes if not already in use, nine tenths of them would clear up promptly without any further trouble. In a series of later trips to the French Front I found bad cases of this distressing condition almost equally rare.

Within the last few months Dr. Flexner, of the Rockefeller Institute, has perfected an anti-toxin against gas-gangrene which is giving excellent results, and which has given the finishing touch to our victory over gas-gangrene.

Incidentally, it may be said that there is a curious confusion, quite common in the public mind, between gas-gangrene and poison gas on the Front. Both are among the blessings of war, but other than that have not, of course, the slightest connection. One form of the confusion is the idea that gas-gangrene is the result of gas from the bombardments getting into the wounds! But vile and abominable as gas-clouds and gas-shells are, and heavy the disgrace and we hope punishment of the German brutes who invented them, their gas, chlorine, has no injurious effect upon wounds even if it happens to be blown into contact with them. On the contrary, though somewhat irritating, it would have a distinct anti-septic effect.

Operative surgery for the last thirty years has been a singularly open and above-board game, with all the cards on the table, and clear, definite rules. If you played according to the rules, you won, in the sense of swift healing, "union by first intention," as it was called, — no fever, no pus. If you lost by so much as a single drop of pus or a degree of temperature, it was because you had used bad judgment or overlooked something.

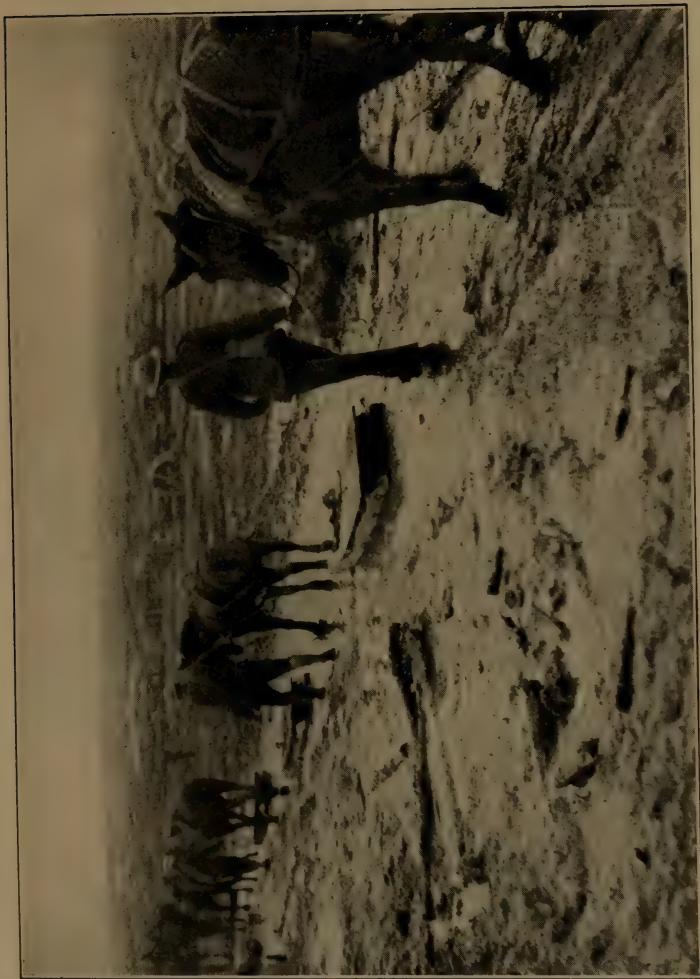
The tissues of a healthy body contain no pus germs; the skin has only a few feeble types occasionally inhabiting it; hence, if the patient's skin was well washed and sterilized, and the surgeons and nurses

kept their hands and gloves and dressings surgically clean and sterile, there would be no germs in the wound and consequently no pus and no fever.

So confident and so conscientious were some great operators that they actually had printed and hung up in their hospital wards cards with the motto, "Every patient whose wound suppurates has a right to demand the reason of his surgeon."

Feeling sure that there were no germs anywhere in the wound, and that therefore there would be no "matter" or pus to provide for, draining by rubber tube or gauze strips was unnecessary. The wound could be closed at once, its sides brought carefully together and stitched almost as tight and smooth as a tailor would patch a rent in a coat.

In most operations which had not been done on account of some inflammatory or infected condition, the deliberate aim was to leave no gap or cavity anywhere even in the deepest part of the wounds, but to bring both walls or lips of it firmly together from bottom to top. And surgeons vied with each other in devising ingenious forms and combinations of stitches which would produce "perfect coaptation": usually at least two sets and sometimes even three or four of stitches — a deep one, of silkworm gut or even wire, to draw the deepest parts of the wounds together, one or two intermediate layers of stitches to draw together the muscles and the fatty and connec-



SLEDS USED FOR CONVEYING THE WOUNDED THROUGH THE MUD ON THE FRENCH FRONT

tive tissues under the skin; finally, a row of very fine catgut or silk to bring the skin together almost as smoothly and accurately as a glove-maker would stitch a seam in a glove — in fact, one of the most popular skin stitches is known as the “glove-maker stitch.”

Some surgeons would deftly put in this last row of stitches from below, catching only the under surface of the skin, without piercing it at all, so that when this “underground” zigzag was drawn tight, the lips of the wound came smoothly together without any sign of stitches. And as all the other rows of stitches were buried deep in the wound, there was nothing whatever to be seen but a thin red line along the skin where the wound had been. These buried stitches or sutures were of catgut or silkworm gut, because these being animal tissues would be melted and absorbed by the fluids of the body in the course of a week or so.

But with the outbreak of this war all this finesse had to be thrown to the winds. Just imagine the change, the humiliating descent from this scientific accuracy, this faultless handiwork, and kidglove embroidery finish, to the clumsy, wide-open, free-drainage methods, which were the only ones applicable or possible in dealing with the jagged gashes and caverns and craters, torn by high explosive shells. Gone were our cherished dreams of sterile

wounds, of perfect closure, of hairline skin sutures and narrow scars. We were thrown right back to the old rule-of-thumb, pre-antiseptic motto, "Cut through everything soft, saw through everything hard, and tie everything that bleeds."

At first we made a noble, half-despairing attempt to preserve our beautiful technique and perfect finish. We cleaned out the ragged, blackened, gaping wounds as best we could, we tied the bleeding arteries, we trimmed up their ragged edges, stitched them together in as neat a seam as possible, and "trusted in an all-wise and unscrupulous Providence," as a surgeon cynic in one of the big field hospitals remarked.

We did not have long to trust, for the prompt result was an explosion of gas-gangrene and tetanus, such as we had n't seen for sixty years; indeed, we had fondly imagined that we never should again.

Of course, shell wounds in this war were nearly five times as numerous as ever before, but still we had had quite a considerable experience in shell wounds in the Boer, Spanish-American, and Russo-Japanese Wars, and never anything like this as a result.

We were not left long in doubt — no sooner had we scraped up a little of the soil of the battle-field, dissolved it in water, and put it under a microscope than we found it swarming with tetanus germs, and another germ criminal, known by the musical and poetic title

of *Bacillus gasogenes* (*perfringens*), also, to be perfectly exact, *Welchii*, in honor of its discoverer, the famous Dr. Welch, of Johns Hopkins University.

The tetanus bacillus caused the lockjaw, and the other germ, with a name like a Spanish hidalgo, caused the gas-gangrene. So the mystery was solved.

Why had n't we got similar results from our shell wounds in the Boer War and the Russo-Japanese campaigns? A little further investigation and reflection quickly told us. The Boer War had been fought chiefly over barren naked veldt or rocky hills, with scarce a trace of cultivation about them, and the Russo-Japanese War had been fought over a richly cultivated country, but one in which little or no horse manure had been used as a fertilizer, for the reason that there were extremely few horses. The battles of the Western Front were on the most intensively cultivated and heavily fertilized land in the world, enriched chiefly by stable manure, and as the normal habitat of both the tetanus bacillus and the gas-bacillus is the intestines of the horse, the soil was simply swarming with them both.

Once we had seen the enemy he was soon ours. A message flashed to the laboratories on both sides of the Atlantic set them turning out the tetanus anti-toxin, literally by the gallon. The Laboratory of the Health Department of New York City alone, for instance, supplied over seventy-five thousand

dollars' worth of anti-toxin and typhoid vaccine in one year. Every severely wounded man was given a preventive injection, and lockjaw swiftly declined to the vanishing point, where it has been held ever since.

IX

HEALING THE WOUNDS OF WAR, OR THE CARREL TRIUMPH

THE trench seems to have put its stamp on the whole of this war. Even the wounds inflicted in it are almost trench-like in their depth, their complexity, with traverses, saps, and branches reaching in every direction, and above all in their difficulty of drainage. At first sight one's feeling is one of astonishment that such a network of burrows, such a system of underground works could have been constructed in the human frame.

I have seen a surgeon thrust his sterilized gloved hand in under the shoulder blade behind, and bring it out under the arm-pit in front, with plenty of room to move his arm up and down; and yet, the lung having marvelously escaped being penetrated, and the nerves and arteries not torn across, the man made good recovery, with a fairly useful arm.

In another "blessé," a powerfully built "Chasseur à pied," there was a cavity in the great muscles of the lower part of the back which looked as though a small-sized shrapnel shell had buried itself down to the backbone, and then exploded. Mercifully, the spinal cord was unhurt. The walls of the huge crater,

into which you could have packed a half-dozen oranges, were as clean as a fresh-caught trout. The man was making rapid progress toward recovery, though it would leave a scar about the size of a frying-pan.

Another young Hercules, a "Diable Bleu," who lay waiting his turn on the operating table, was pointed out to me by the surgeon as having fourteen different wounds large enough to count, — and they don't count little ones on the Front, — and yet his pulse and color were good, he stood the operation finely, and in a few days he was considered out of danger.

What men kept in perfect condition can stand and what surgery can do are two of the marvels of this war. The problem before the surgeon was a complicated one, like the wounds. They were deep, irregular, pocketed wounds, not only very difficult to drain and close smoothly, but also packed with bacteria of the soil, carried upon the fragments of the shell. These bacteria, coming from the depths of the soil, and living on decaying vegetable and animal matter, found just the conditions that were needed for their growth, in the depths of the shell-wound; that is, absence of oxygen or air, and the presence of dead or dying animal matter in the flesh destroyed and shattered by the shell fragments.

In the earlier days of the war before the problem

had been solved, they did so flourish and produce a good deal of gas-gangrene. The wounds were so irregular and many-pocketed, the dirt containing the bacteria driven so deeply into the flesh itself, that it was impossible to get them clean, in the sense of clear of bacteria, by any process of washing or scrubbing however vigorous, and the consequence was that these bacteria were constantly dropping into the cavity of the wound for days or weeks after the injury. It was impossible to clear them out before they could begin to grow and produce their poison, even by dressing the wounds twenty times a day, had this been feasible.

The only thing, apparently, to be done was, so to speak, to attack them in their lair, by keeping the wounds constantly flushed with some fluid capable of destroying the growth of the germ.

Scores of surgeons and bacteriologists were working on this problem, but it was first perfectly solved by the genius of a brilliant young French surgeon, Alexis Carrel, born and educated in France, who had lived for years and won national reputation in America as a discoverer and research worker in surgery.

Carrel's method of attack against these wound bacteria was a twofold one: first, depriving them of the food on which they could live; second, poisoning them as fast as they came out of the walls of the wound, before they could begin multiplying or get

a first foothold. His first great advance was his discovery, after months of careful observation in the hospital and experiments in the laboratory, that these bacteria could not live upon living tissue, and that, therefore, in cleaning the wound out at the first dressing or operation, it was not necessary to get rid of all the bacteria, but only the dead and damaged fragments and surfaces of the tissue which would furnish food for them to live upon.

This simplified the problem considerably, for while it was impossible to get rid of the bacteria buried down in the flesh, it was practical to clean the wound, so as to get rid of all the tissue that was dead or likely to die.

Of course, it is not always possible to do such a cleaning completely in deep and extensive wounds, and, for instance, as a surgeon with whom I talked put it, with a touch of high dramatic exaggeration, "If I were to trim away all the badly damaged tissue in some cases, I should have to trim away half my patient." But in the great majority of the cases a very searching and thorough house-cleaning of the wound, called by Carrel "*débridement*," can be carried out with such excellent effect that one of the most prominent of French surgeons assured me that a thorough "*débridement*" was nearly two thirds of the battle for recovery, and was almost the most important part of the Carrel treatment.

But the motto of the surgeon must be "thorough." No matter how huge or gaping the wound, or how broad the scar appears likely to be, so far from saving every scrap and vestige of skin that is possible, so as to close it over the wound, the surgeon deliberately goes round the whole edge of it with his scissors or scalpel, and cuts off a strip one third or one fourth of an inch wide, because experience shows that, although it even looks healthy, it has been so badly damaged by the slash of the shell that it is certain to break down and become a source of infection to the wound.

Then the wound is explored by sterilized fingers and drawn open as widely as is safe and feasible, to get a clear sight of its sides and bottom, and all particles of torn, crushed, or badly damaged flesh, or fragments cut off from their blood supply, are cut and scraped away. As a final touch a pad of gauze is drawn over the end of some blunt instrument, and the whole inner surface of the wound scrubbed and scraped with it.

In wounds that go right through from one side of the limb to the other, I have seen a good-sized strip of gauze pushed through, and then the surgeon takes hold of the two ends, one in each hand, and saws backwards and forwards through the wound, so as to clean out thoroughly every scrap of badly damaged tissue.

This thorough scrubbing-out and "laundrying" of the wound takes time and trouble and looks at first sight rather drastic and heroic for the patient, but he is, of course, under ether, and feels nothing, and the rapidity with which wounds will begin to heal after a thorough cleaning and "débridement" is something most gratifying.

So striking and unmistakable are the benefits of this thorough "débridement" that practically all surgeons, and even advocates of other methods of treating wounds in war, are in favor of it. In fact, some are so delighted with it that they claim to have invented it themselves, or attempt to deny that it is an essential or original part of the Carrel treatment. But the documentary evidence is fatally against them.

The second great step is that of the continual irrigation of the wounds with an antiseptic fluid strong enough to kill the germs; but not irritating or dangerous to the tissues of the body itself. This last requirement is by no means as simple as it sounds, for ever since the very first discovery of antiseptics by Lister, the medical profession had been driven more and more strongly to the conclusion that almost all antiseptics capable of destroying germs were even more capable of damaging the tissues of the body. To put it very briefly, we were more easily poisoned by them than our germ visitors were.

So far had this conviction gone that the vast majority of surgeons objected to the very name "antiseptics," which means literally, "against infection," poisoning the germs after they had got into the wound. They insisted upon a new term, invented after Lister, "asepsis," which means "without infection," never allowing any germs to enter the wound from the patient's body, the surgeon's hands or instruments.

The majority of our surgical operations within the last twenty years have been carried out on this aseptic plan, using no germicides on the instruments or surgeon's hands, and nothing at all in the wound except sterilized water or a little alcohol. So that it was entirely against our modern, and already traditional, practice and ideas to attempt to use antiseptics for the purpose of killing the germs in wounds. A hundred eager objections were made to prove at once that any antiseptic fluid was necessarily a poison to cell life, and must be far more dangerous to the cells of the patient's body than to the germs. This accounted, in considerable degree, for the tremendous prejudice and opposition on the part of many doctors to the Carrel treatment in the beginning, a prejudice that was scarcely creditable to the open-mindedness of the medical profession.

The Dakin-Carrel antiseptic fluid might and even should do more damage to the patient's body than it did to the cells themselves, but there was absolutely no

denying or getting away from the fact that a patient treated with it got well in less than half the time than under any other, and even though a few cells be destroyed, the millions left seemed to be invigorated by the process. The Carrel treatment, even with its innumerable modifications, has done more to save life, save limbs from amputation, to diminish suffering and hasten recovery than any other surgical procedure of the war.

One of the most striking features of this war is the way in which strange and unexpected things have suddenly become enormously in demand, expensive and difficult to get in proportion. If, for instance, twenty years ago any one had mentioned rubber or cotton as among the most vital necessities of war, he would have been laughed at. Now one of the sternest practical difficulties which concerns the hospital is how to rescue enough rubber for its purposes from the maw of the ever-devouring motor, and cotton for its dressings from the seething vats, in which the soft innocent stuff is turned into fierce and deadly explosives of the gun-cotton and nitro families.

In the case of rubber, the doctor has the slight consolation of knowing that part of this keen competition is between two humanities: the rubber tires of the blessed and unspeakably useful motor ambulance, as against his gloves and irrigation tubes. It

would scarcely be too much to say that these two uses of this curious vegetable gum have done more to lessen the sufferings of the wounded than any other two non-human agencies in this war. The old proverb should be revised to read, "There's nothing like rubber."

One of the greatest practical difficulties which the spread of the Carrel treatment had to fight, next probably after the native inertia of a certain type of surgical mind, was the scarcity and expensiveness of rubber. The second part of the Carrel method, which comes after the "*débridement*," requires rubber tubing literally by the yard for every patient.

It was painfully easy for those who on various grounds were not willing to adopt the treatment to cry out, "Oh, we can't possibly secure all that quantity of rubber tubing, or stand the expense if we could get it." But as the total cost of an irrigation equipment, averaging five yards of tubing, flasks, nozzles, clips, and all included, is a little under three dollars and it lasts a month, that argument does not survive much investigation, considering that it shortens the time of healing, on an average one half, and in some cases more, saves the patient's strength by diminishing suffering, and markedly lessens the necessity of amputations. No good business man would ever hesitate over the question of investing such a sum.

For instance, one of the best-known American

surgeons in France, Dr. Blake, has the proud record of treating a thousand successive cases of serious wounds under a modified Carrel method, with *only four amputations*; and the position of his hospital was such that only grave cases — mostly bad fractures, and fully one third of them raising serious question of the need of amputation — were sent to it.

The equipment for irrigating every nook and corner of the wound is the most ingenious part of the Carrel treatment, and from the fact that it is also the most visible, the one that is constantly to be seen in operations at all hours, by all visitors to the ward during the whole weeks-long course of healing, it has come to be looked upon as being the treatment itself.

In one sense it is extremely simple, merely a pear-shaped glass flask, known as an "ampoule," suspended from an upright rod fastened to the head of the bed, with a long rubber tube leading from its lower opening down to the wound, and there breaking up into a large number of smaller tubes. The rim of the mouth or upper opening of the ampoule is flared out, so that it can be easily held by a clip or a cord, and it is raised about three or four feet above the level of the mattress to give the pressure that has been found necessary properly to flush the wound.

At first sight it might be thought that a single tube inserted into the deepest part of the wound

should be sufficient to flush it; but this was very soon found to be insufficient. Water has a most fiendish and ingenious way of hunting and finding promptly the shortest way out of a particular pocket, and then flowing slowly and blissfully along that course, leaving almost untouched all the rest of the area that it is supposed to be irrigating.

This was first met by tying up the tube at the bottom of the wound and punching from ten to twenty holes in its side, so that the water would start back from a dozen points instead of one. But even this was not sufficient, so a smaller blind tube with side perforations was passed into the bottom of every one of the pockets and corners of the wound, and this method was found to meet the situation and to attack and overcome the germs in their own dens. So that if you look closely at the dressings of a beautifully clean and comfortable "blessé" under the Carrel treatment, you will find that the large tube leading down from the ampoule to the wound ends just above the dressings in a little glass distributor, or forked tube, breaking up into as many branches as there are smaller tubes required to reach every pocket of the wound; for two pockets there will be a simple "Y," for three, four, or five, more, a curious little multiplier of the shape of a comb with hollow back and teeth.

A very large and deeply pocketed wound may have

as many as ten or even twelve tubes. Naturally the placing of these numerous tubes judiciously and carefully, so as to keep every corner of the wound flushed, is a question of skill and careful irrigation on the part of the surgeon.

Now comes the question of the flow of the fluid. At first sight it would appear that a gentle, continuous irrigation would be decidedly the best method, secured by a very slow, continuous flow all day and all night. Accordingly, a very ingenious drop by drop apparatus was introduced into the big tube, and a gentle, soaking, continuous flow adopted. This worked admirably and is still Dr. Carrel's personal preference for the treatment of surgical cases.

Other surgeons, on the other hand, who enthusiastically adopted the Carrel treatment, declare that in their experience this method has the disadvantage that as the pressure under which the water flows is decidedly low, these little openings at the side of the tubes — which, of course, are very small, hardly larger than a good-sized darning-needle — are apt to become clogged up by scraps of lint, matter or pus, and then the fluid begins to short-circuit itself out of the wound by another channel.

Another objection, which is rather a serious one practically, is that the business of the water being to find its way out of the wound as continuously as it is poured in, first saturates the dressings and



ARRIVAL OF WOUNDED AT A FRENCH BASE HOSPITAL



then overflows from these out over the bedding and clothing of the patient, and finally, if not most ingeniously headed off by rubber sheetings, into the mattress itself.

The method which they prefer is the alternate one, also discovered by Carrel, of short flushings at regular intervals. A spring clip is put on the long tube and the nurse releases this every two hours by the pressure of her fingers, and allows the water to flow for a period depending on the size of the wound, on an average three minutes. This gives sufficient force to drive any clots or obstructions out of the little holes in the tube and to force water into every corner, like a broom; and also, from the nurse's and hospital management point of view, it enables them to watch the result of the flow and to check it as soon as the flooding appears on the surface of the wound, thus avoiding a good deal of troublesome overflowing and leaking which is quite uncomfortable for the patient. Carrel himself, however, holds that the very best ideal results can be obtained by the continuous flow.

This is the standard or "full" form of the treatment, but there is another modification of it which may be used, in first-line Field Hospitals, for instance, or under other circumstances which render it difficult to secure or erect the flush tanks or ampoules; that is, putting the numerous little tubes and

distributors into the wound as usual and then flushing out at regular intervals by the use of a glass syringe.

Carrel's collaborator, Dakin, has devised a special glass syringe of very simple shape, that can be easily sterilized, and one is provided for each patient, so as to avoid risk of infection. This method of flushing with a syringe is one of the earlier ones adopted by Carrel, to be abandoned later in favor of irrigation. It does not give as perfect results and means more work and trouble for the attendants, but it may be used as an emergency substitute, when the ampoules and long tubes are not available, with quite satisfactory results. It has also the practical result of reducing the cost of the total equipment by about one third.

Last comes the question of the antiseptics that should be used in the fluid. The situation in this campaign is not unlike the historic epigram of Henry of Navarre, on fighting in Spain. He declared it was such a poverty-stricken, hard-hitting country, that if you went in with a small army, you were beaten; with a large one, you were starved. In order to get some antiseptic that killed the germs without doing more harm to the tissues of the patient, after many skillful and patient experiments by Dr. Carrel and Dr. Dakin, a young English physiologic chemist who was Dr. Carrel's associate in this part of the work,

the ingenious idea was hit upon of devising an anti-septic which within a short time would be neutralized or made harmless to the tissues by the lymph that flowed into the wound, and yet which within that time would have been able to destroy or prevent the growth of the germs present.

The chemical which they found to fulfill all these different requirements and give best practical results was not a new one, but a modification of an old medical friend and stand-by, bleaching powder, popularly known as "chloride of lime," or "eau de javel" in France.

This sloppy white powder, which we have all seen and smelt sprinkled about sinks, laboratories, and wherever disinfection is supposed to be in order, like a good many other common things is rather a complicated body. But the secret of it, put very crudely, is that it contains and conveys a small amount of the extremely powerful and poisonous germicide and disinfectant, chlorine gas, and this while very irritating at first, soon after coming into contact with the fluids of the body and their large content of sodium is changed into a harmless chloride of soda, or common table salt.

Grotesque and almost incredible as it may sound, this same poisonous and irritating gas — chlorine — which can be used to kill germs and heal wounds, is the one which is the chief constituent of the

terrible poison gas-clouds and gas-shells as originally devised by the Germans, and the change to harmless common salt, which takes place in the Dakin solution in wounds, is the same one which enabled the soda-moistened folds of the earlier gas-masks to protect our soldiers.

The Dakin solution, of course, required the most elaborate and delicate modification of the chlorine powder, first to get it of the exact mean of strength strong enough to do its work, but not strong enough to harm the patient, and then to neutralize, as the chemists say, its alkalinity or "soap-likeness," so as to prevent its irritating the skin of the patient under the dressings after it had flowed out of the wound. This was finally found to be best done by a careful addition of boric acid, and the perfected antiseptic, "Dakin's Fluid," is a marvel of ingenious and delicate adjustment to the particular work it has to do. It is customary to color the completed fluid pink with some harmless dyestuff, so that the nurses can see the level of it in the glasses and ampoules, as any one will see if one visits the hospitals, but this has nothing to do with its antiseptic effects.

Finally comes the interesting and important practical question. How do we know that this ingeniously adapted solution is doing the work required of it, killing the germs and promoting the healing of the tissues? To find the answer to this question the most

painstaking and thorough research and experimental work of any part of the process were carried out by the Carrel staff. It is impossible to give more than the very rudest explanation, but it may be roughly said that track of the progress of wound toward recovery is kept by two entirely separate methods, which keep check upon one another.

One is the daily counting of the bacteria which are present in the depths of the wound itself. At the time of each dressing, delicate instruments are introduced into the depths of the wound, bringing back drops of the fluid present. These are spread upon microscopic slides, stained, and the number of bacteria contained in five or ten dips counted. If the wound is doing well, the number of bacteria should diminish markedly from day to day, and when they have fallen to a very low level and remained there for several days, it is then considered safe to do the thing so dear to the heart of the modern surgeon, which under pre-war conditions would have been the first step; that is, putting stitches into the lips of the wound and sewing it up tight.

The method is of peculiar value, because in the open treatment of wounds, the great difficulty is in knowing just when it is really safe to close them. This is vitally important, because, if they are allowed to granulate up from the bottom, it takes an enormous length of time, and what is almost as undesirable,

leaves a huge and not only disfiguring but crippling scar.

A wound of great length and extent successfully treated by the Carrel method can finally be closed up and healed, with only a little more scar or deformity than would be left by the closing-up at once of a clean wound. This method diminishes the risks of crippling and the number of cripples very markedly.

As for amputations, an eminent French surgeon made a collection of over two thousand done in the earlier days of the war, and found that seventy per cent of them were made on account of severe infections of the wound, and at least two thirds of these could have been prevented by the Carrel method.

The other method of keeping track of the progress of the wound is the simple, but rather laborious, one of measuring its actual superficial area. Carefully graduated calipers are employed and the most elaborate mathematical formulæ for calculating the square surface used, as well as tracing the actual shape and size of the wound on transparent paper, then transferring it to the pages of the record.

On the basis of thousands of cases followed and recorded after this fashion, Carrel has actually been able to work out a mathematical formula for the rate at which a wound of given size and depth in a patient of a given age, ought, under proper conditions, to heal.

It would be tedious to go into details, but the omnipresent and universally employed "curve" has been utilized. A line of curve is plotted that shows the rate at which a given wound, of this size ideally treated, ought to heal, and another curve is plotted from the bacteria-count test, and the two curves are found to run closely parallel. It gives you an almost uncanny feeling to be shown, in the history room of Dr. Carrel's splendidly equipped hospital at Compiègne, a diagram showing what is the rate at which a given wound ought to heal. This was, perhaps, laid out fifteen days ago; the case is still in the wards; you go and see what his actual curve of progress has been, and it is seldom that the two curves differ more than five or ten per cent. If the surface of the wound ought to be, say fifty square centimeters on the fifteenth day following, it will usually be between forty-five and fifty-five square centimeters in area.

Then, with this as a basis and standard, a most careful process of testing out different antiseptics and methods is gone through with, including all the rival solutions which have been suggested by other surgeons or improvers upon this method. It was fascinating to note how promptly and certainly a rapidly falling curve of bacteria in a wound would turn and rise within twenty-four hours after some less efficient form of antiseptic had been employed, and how it

dropped back to the normal again after this had been discontinued.

Several other antiseptic solutions besides the Dakin were found to give excellent results for some time, in cases that had started toward recovery under the Dakin, but upon more prolonged trial it was found they could not be relied upon to meet complications, which arose in the form of new outbursts of germ growth in the wound, and the Dakin had to be gone back to to bring these under control.

It would be hard to imagine anything more absolutely founded upon cold, actual demonstration and test, and the feeling conveyed is irresistible that if any other fluid suggested had given better results than the Dakin, the latter would have been promptly and ruthlessly discarded in its favor.

Incidentally, it may be remarked that the age of the patient was found to have a striking influence on the curve and the rate of recovery. The younger the soldier, the more rapid the healing in the beginning, which supports the preference of military authorities for young recruits. On the other hand, there was a curious after-check, and that was that although the wounds in the older men healed much less rapidly at first, they began to catch up later and in the end healed not only as firmly and solidly, but within fifteen or twenty per cent as soon as in the youngsters.

The older man's power of healing is slower in the beginning, but it arrives in the long run. Some day, as I suggested to Dr. Carrel, half jokingly, it may be possible to get from this rate of wound healing some sort of mathematical test as to what is the real age of a man. But, of course, no one would venture to hope for any such certitude about the age of a woman.

X

THE STRANGLERS

THIS is a gas war. Not, alas! a gas-bag war, in the sense of long-distance windy contests as between World's Champions or Mexican Revolutionists, but in the sense that gas is the life breath of the whole "show." Gas hurls and explodes its shells and shrapnel; propels its airplanes; pushes its monster guns, its motor "camions," its ambulances; drives its submarines and their chasers; fills the domes of its censors; and serves directly as one of the most gruesome of its deadly weapons. Less directly and obviously it heals the wounds and purifies the drinking-water, for the very same deadly chlorine which makes up the bulk of the gas-clouds is the antiseptic in the Carrel treatment, and in the sterilizer in the bleaching powder used to purify the drinking-water of the armies.

And of all the features of this most terrible of wars which have attracted the most horror-stricken attention and produced the most world-wide outburst of disgust and loathing against Germany, poison gas is easily chief. It is hardly too much to say, in the language of the standing form of newspaper reports of suicide, that when Germany turned on the gas

she blew out her brains, so far as hope of finally winning the war is concerned. And when the much-debated question of the name by which this titanic world-struggle shall go down to history is finally settled, it may easily happen that its title will appear as "The Great Gas War."

And it would be distinctive, for it is the first, and will most emphatically be the last, in which this atrocity is permitted, unless God has abdicated in favor of Germany. On my trips to the Flanders Front, the most striking signs which met the eye everywhere, in the squares of the little villages, on the walls of the public buildings, and Headquarters, along all the roads leading to the Front, were great posters blazing the word "Wind safe" or "Wind dangerous" for gas attacks; though, I am happy to say, for reasons explained later I only saw the "Dangerous" signal two or three times in as many weeks. And as I first looked over the kit of the soldiers most of its contents looked quite familiar: there was the haversack, the blanket-roll, the canteen, the mess-tin and cup, the revolver, the rifle, but one prominent object struck the eye as new and strange. This was a large rectangular case, or box, about fourteen inches square by three or four inches thick, slung from the shoulder or round the neck like a pair of field-glasses. Across its face was printed in large staring letters some dramatic warning in Italian; for instance, "Chi

si leva la maschiera muore!" — "Who leaves the mask dies!"

Gas has proved a great disappointment to its inventors. There is abundant evidence to show that when the German General Staff started their clouds of strangling chlorine rolling across the level flats of Flanders toward the Canadian trenches before Ypres, they confidently and gloatingly expected either to send their defenders flying headlong in panic-stricken terror, or to suffocate them where they stood, and then come forward and pick up the pieces and occupy the position at their leisure. But they swiftly bumped upon the two rocks which have wrecked their whole programme of gas-drives ever since. First, that determined troops with any kind of a wet cloth tied over their mouths and nostrils will hold their ground in the thickest of gas-clouds. Second, that if you make your gas-clouds thick enough seriously to embarrass the enemy, you find them extremely uncomfortable for your own troops to charge into for at least one half to three quarters of an hour afterwards.

While part of the Canadians fled, coughing and gasping, before the ghastly, green, choking cloud — and who could blame them, utterly unprotected and unwarned as they were — a few stood their ground doggedly and died in agony, while the remainder, a considerable minority, hastily grabbed up or tore

off pieces of any sort of cloth that they could lay hands on — first-aid dressings, handkerchiefs, shirts — and bound them respirator fashion across their noses and mouths.

This helped, but it was n't enough. Like a flash an inspiration came to one big Canadian sergeant. He tore off his dry bandage, saturated it by a method which is as primitive as it is unfit for publication, tied it on again, and found he could breathe with comfort. He ran down the line shouting his discovery. Man after man followed his example, and when the German shock-troops came stumbling blindly but confidently through the twilight of their own gas-cloud, to occupy the deserted trenches, they met such a hot and hornet-like reception that very few of them went back across No Man's Land to tell the story of their failure.

And this was a fair sample of the luck that has attended gas-attacks ever since. It is hardly too much to say that gas in clouds has proved the greatest false alarm of the war. In a few instances, where it has been used upon "gas-green" troops — that is to say — raw levies — either unprovided with gas-masks or untrained in their use, as once or twice, for instance, on the Galician Front on the Dunajec River, and once on the Italian Front, — it has produced headlong flight; but it is the opinion of some military experts and particularly of those on Boards of Gas

Warfare, that it has seldom determined the result or even turned the scale in a single important battle. But when first sprung as a surprise on unsuspecting raw troops it was sometimes a ghastly success.

When used against seasoned troops with good gas-masks, though it unsettles their nerves and annoys their finer susceptibilities extremely, instead of running away they have a habit of holding their ground, and taking out their exasperation on the storm-troops that follow the gas-cloud. While the protection of modern masks, with reasonable vigilance and intelligence, is so nearly perfect that while precise figures are withheld for obvious reasons, it is, in the opinion of those who are in a position to know, doubtful whether the deaths from gas exceed one or two per cent of the total mortality of the war. In fact the only danger of its further use in future wars is the fact that it has not proved as deadly or as cruel as was hoped by its inventors.

For instance, on one mountainous section of the Italian Front which I visited, where very few gas-attacks had been attempted by the Austrians on account of the height and direction of the almost incessant mountain winds, one summer afternoon it fell calm and still, and the fiends saw their chance for a choice bit of "Schrecklichkeit"! From the upper end of a long, sloping, high-walled valley, filled with men and horses at their evening meal, they

launched their murderous clouds, and in twenty seconds the whole glen was a hell of agony and death. Men, horses, mules rushed madly down it, strangling, gasping, fighting, trampling upon one another in a wild rush to escape the deadly fumes, but in vain. Some of the soldiers had laid aside their masks, some rushed panic-stricken downhill without waiting to put them on, others pulled them on and then, feeling half suffocated in their rush, tore them off again to breathe freer. When at last the fates took pity and a sunset breeze lifted the strangling clouds, nine thousand men lay gasping and choking in agony, and four thousand of them died, in spite of the most heroic efforts of the doctors! "It was a glorious victory," but Heaven help the man or men to whose account it will be charged in the great Book of Judgment, the verdict of history! Moreover, it was utterly barren in a military sense, as before the valley was clear enough of gas to allow the Austrians to advance down it, the Italians had thoroughly lined its sides and rim with machine guns.

In the minority of cases, in which it is successful in driving back the enemy, it probably gains small amounts of ground at lower cost of life than either shell- or rifle-fire.

But it punishes the poor wounded terribly, for most of the Dressing-Stations have to be underground, and hence are liable to be "flooded" with

gas, which runs down like water and strangles them like rats in a hole. Most Dressing-Stations I visited in Flanders had an "air-lock" at the entrance consisting of a heavy blanket-curtain soaked in soda solution, which you lifted to enter. Then it could be dropped behind and your clothing sprayed with a soda spray if a "cloud" was on, then another wet blanket in front of you was lifted and you entered the tunnel ward.

Like almost everything else in this supposedly most modern and scientific of wars, there is nothing new about the use of poison-gas. The famous stink-pots and smoke-makers of both Oriental and Mediæval warfare were exactly the same in principle and intention. For although the horrible reeks which they gave off were for the most part as harmless as they were abominable, they were regarded as extremely deadly and held in terror by the warriors on both sides, on account of the ancient mental association between vile odors and demons and devils and black magic generally.

In fact, this method of warfare was invented long before the human species, the most ancient and honorable practitioner of the art being a little beetle, styled by the French "le bombardier," who when frightened discharges a jet of most vile-smelling and acrid gas or spray in the direction of his enemy. His shot is most ingeniously fired, too, the stink mixture,



TRANSPORTING WOUNDED TO A FIELD DRESSING-STATION ON
THE SALONICA FRONT



BRINGING IN A WOUNDED CANADIAN THROUGH THE MUD
ON THE WESTERN FRONT



which is acid, being suddenly discharged into a little cavity under his tail shell, where it meets an alkali; is turned into a gas, and exploded, by the force of its own expansion, through the muzzle of his tiny trench mortar. Of course, the oniony "tear-gas" spray of the sable and silver nocturnal disturber of the peace of our poultry yards is a household word. The German Board of Gas Strategy can proudly cite before the next Hague Conference precedents as ancient as they are appropriate, in the skunk and stink-bug.

There is abundant evidence that the German chemists and their laboratory staffs, under the direction of the Great General Staff (like everything else in Germany or under a German hat, for the last half-century), had been experimenting industriously for years to decide upon a poison gas suitable for use in war. This is proved partly by the capture of gas-containers stamped with the dates "Model of 1909" and "Model of 1911" — I happen to have been personally assured of this fact by a member of the Belgian Relief Commission who had seen gas-cylinders so dated; partly by the fact that the Germans were importing drugs which were of no possible value except for the manufacture of "tear-gas"; and partly because the very first gas that they used — chlorine — has remained the chief staple of their gas-clouds ever since, showing that it was the survivor of a long and rigid series of elimination tests.

The masks used against gas-clouds were simple face bandages dipped in a solution, first of ordinary baking or washing soda, later of sodium hyposulphite, such as is used in developing photographs, because it lasted longer and was less irritating to the skin, and cans or jars of this solution were kept standing about in the trenches to moisten the masks when they dried out. Those simple soda solutions, by one of the blessed miracles of chemistry, combine with the burning, strangling chlorine gas and turn it in a flash into harmless common table salt (sodium chloride)! Later a little glycerin was added, because by its power of attracting moisture it kept the masks from drying up so quickly.

This was all very well as a temporary measure, and these little home-made, hand-dipped masks did yeoman service in many a gas-cloud for several months. But when it had been recognized that gas was going to prove a permanent institution in this war, something more business-like and more effective was called for. This took the form of a helmet or bag of twenty or thirty layers of gauze with goggles of glass or celluloid for the eyes, pulled on over the head and cap or helmet, much like the veils used by bee-keepers, and then tucked down under the coat-collar and buttoned in.

This was a great improvement, because it not only protected the lungs from the poison gas, but also

the eyes from "tear-gas," but it was hot, stuffy, and greatly limited the field of vision as the disks of glass or celluloid hung some distance out in front of the eyes. Moreover, it was found that when phosgene gas began to be extensively used, the bag or helmet mask was a very imperfect protection against it.

So the War Department called in the chemists and physiologists and the inventors and put their wits to work, with the result of producing about two years ago a mask which is an almost perfect protection against every known kind of gas which German deviltry has been able to invent, which can be worn if necessary from twenty-four to forty-eight hours at a stretch, which one can sleep in, fight in, play football in if desired.

It is far and away the best mask in use in all the armies, and has been adopted in its entirety with certain additions and improvements by our American army. Some of the French troops use it, and when the Russians were still our allies, a considerable number of these good masks were supplied to them. But most of the French, and all the German, Austrian, and Italian troops, are still supplied with a very inferior mask of the "nose-bag" type, whose sole advantage is that it is cheap, light, and easier to carry than the more elaborate English and American "box" type.

For obvious reasons, no details of the construc-

tion of this mask can be given except roughly to say that the air is purified of gas by being drawn in, not through layers of gauze, but through an oval box of about the size of a tomato can, filled with whole layers of different chemicals and absorbents which can be added to or altered at will, as new gases are introduced. As this box respirator hangs down upon the chest at the end of a rubber tube the size of a large garden hose, this combined with the goggles gives a curiously elephantine, or extinct monster-like appearance to the face of the wearer.

Some of the German and Austrian masks also have a box respirator, but these are far inferior in neutralizing and protecting power to the English and American ones. The feature which makes the mask comfortable for such long-continued wear, is that the breath or expired air of the wearer passes directly out into the open air through a valve instead of being retained within the mask to heat and sweat and suffocate him. With this mask snugly strapped on, our American and English boys are perfectly safe in the densest and most poisonous of gas clouds.

Gas warfare had become a whole department and science in itself, first in the German, and later and most reluctantly in the Allied armies. But unfortunately the whole filthy idea is so utterly repugnant to our sense of decency and fair-play that we have

so far contented ourselves chiefly with countering against each fresh deviltry of the Hun instead of getting right down to play the dirty game wholeheartedly and give him as good as he sends and one better.

There are now in use three main groups of gases, each containing two or more. First of all, the poison gases proper — chlorine and phosgene; then come the tear-shells, or, to give their dictionary name, lachrymatory gases, which is the same thing done into the Latin, whose object is simply to irritate intensely the eyes and produce such a flood of tears as temporarily to blind the soldier. Last and most troublesome of all come the irritant gases which attack chiefly the surface of the skin; these are mustard-gas, nitro-chloroform, and a derivative of picric acid.

Then to make matters still more complicated, any or all of these gases instead of being discharged in clouds are fired over in shells containing tubes of them compressed into liquid form with just enough explosive to scatter them through the air. Indeed, mustard gas can be used only in shells, because it is not a gas at all, but a heavy liquid, and has to be scattered through the air in the form of a spray by some explosive.

Phosgene is a child or near relation of chlorine, its textbook name being carbonyl chloride. To put it

very roughly, it is a combination of chlorine and choke-damp (carbon monoxid) with all the bad qualities of both parents. It is probably the most intensely poisonous gas known, being fatal in about one twentieth of the concentration required for chlorine and has the ghastly trick of producing relatively little discomfort or suffocation while it is being inhaled, and then suddenly toppling over its victim dead of heart failure several hours later.

It is in itself the answer to the frequently asked question — "Why don't the Allies use prussic acid and strangle the whole Hun outfit?" Prussic acid to the Prussians would certainly be most appropriate, but unfortunately it is not nearly so deadly as the less famous phosgene, and has the great drawback of being light volatile, and so rapidly escapes into the surrounding air that it soon becomes too weak to be dangerous.

Phosgene derives its almost musical name from the curious fact that the two gases which compose it can be got to unite only in the presence of bright light. Hence, its Greek title, "light-born." A literal child of light, but most emphatically not of sweetness, and a doer of deeds of most sinister darkness.

It is much more to be dreaded than chlorine, because it is not only ten times as poisonous, but is almost invisible and has a much less powerful odor. The latter is a sweetish, rather aromatic scent, offi-

cially described as resembling that of violets, though to my untutored olfactories it more nearly suggested garlic. A full-blown cloud of chlorine and phosgene combined is a literal "holy terror," blasting and withering every living green thing, grass, leaves, garden crops along the whole of its front to a depth of two or three miles, and killing birds, insects, and small animals, three and even four miles behind the front trenches! The only living thing that can survive it is men or horses in gas-masks, and it has one small redeeming feature, that it destroys all the vermin in the trenches and dug-outs; not a rat, nor a cockroach, nor even a flea or a cootie being left alive.

The cloud-attack method of using poison gas proved a great disappointment to the Hun chemists and commanders, and has already been practically laid on the shelf for the past year or more in favor of gas-shells. Indeed, it was a good deal of a boomerang, and even more unpopular among the German troops than it was among our own. This for the reasons, first, that there was a perfectly tremendous amount of extremely hard and dangerous work in preparing for an attack, thousands of the great gas cylinders weighing from ninety to one hundred and twenty pounds, having to be carried by hand into the front-line trenches, at the rate of one to each yard of the two to four mile front to be gassed. Indeed, in some

of the last attacks they were placed three to every two yards!

In the second place, this whole process was literal playing with fire, for if a single fragment, from any one of the continual rain of shells falling into the front-line trenches happened to strike a cylinder, there would be at least a dozen dead and thirty to fifty badly gassed Germans at once. Third, and not least, by a strange oversight on the part of the All-wise-and-everything-fore-thinking General Staff, they failed to take into account that the battle-line of the Western Front runs mainly, roughly speaking, from north to south, and that the prevailing winds of the temperate zone during the summer are from two thirds to three fourths of the time from the westerly quarters. Therefore, the wind is favorable for carrying Allied gas-clouds into the German trenches just about three times as often as it is for carrying German clouds into our trenches.

To make it worse yet, not only high winds, but any winds above ten miles an hour whisk the gas about and scatter it so quickly as to make it almost harmless. The only winds upon which gas-clouds can be used effectively — the light ones from four to eight miles an hour — are the very ones which are most likely to whirl about and carry the cloud back into, or what is even worse, up or down, the German trenches. And even the good old German God has

declined to interfere and correct this strange perversity of the weather, in favor of his chosen people.

In one blessed instance the wind, after chopping about and holding the cloud in No Man's Land for twenty minutes, swung completely round and swept it back into the Hun trenches killing eleven hundred and disabling over five thousand of their own soldiers.

One of the first methods of attacking and dispersing the gas-clouds themselves was literally fighting the devil with fire. That is to say, accumulating at various points along and behind the trenches piles of brushwood, straw, or other inflammable trash, sprinkled with petroleum, not unlike the smoke-pots and smudge-heaps scattered about through the orchards of Southern California to be lighted to protect the oranges against frost.

Whenever a gas-cloud is launched, all these quick-burning piles down the wind from it are lighted, and the result is a swift, upward-rushing current of hot air which catches the gas and carries it into the upper layers of the atmosphere, at the same time neutralizing it by the gases and fragments of organic matter in the smoke. This is quite an effective protection when skillfully carried out, and the French Surgeon-General with whom I visited assured me that in regions where gas was frequently used even the animals came to know the meaning of it, and horses, dogs, mules, and cats rushed to and crowded

round the fires — having no gas-masks, poor beasts. They were led to the fires for safety in the first place by the men who had them in charge, but after a few experiences all that was needed was to turn them loose and they would rush eagerly to these safety spots.

I found quite an ingenious device adopted in the Italian Army on this same principle — sticking little hedges or rings of short, cone-shaped torches, soaked with petroleum, across the front of all gun batteries and gun emplacements below the level of the ground. These torches are provided with a fulminate so that whenever a gas-shell explodes anywhere near them they “go off” and burst into flames, thus carrying up the gas-fumes and preventing them from pouring down into the gun-pits.

The second type of war gases, the lachrymators (“weepers”) or “tear-gas” shells, can be quickly dismissed. As their names imply, they are vapors, which are not actively poisonous or strong enough to burn or blister the skin, but are intensely irritating to the eyes, producing such profuse and uncontrollable floods of tears that the soldier for some minutes, or even an hour or more, is practically completely blinded by them, and of course for the time being is of very little use for fighting purposes.

In the beginning the chief German “tear-gas” was made from the seeds of a tropical grass known as “sabadilla,” and discovered by the extreme annoy-

ance which it caused to laborers clearing the Central American jungle for rubber or cocoa plantations. It transpired that Germany had been importing these seeds by the ton for years past, for what purpose no one could guess until the war broke out!

Of course, as soon as German commerce was swept from the seas by the English Navy, this source of "tear-gas" was cut off, and they have since been using an intensely "oniony" synthetic compound known as xylol bromide. And another whose name is utterly incapable of pronunciation, except that it has a "form" in it, which gives a formalin clue to one secret of its weepiness.

These "tear-gases" are always fired in shells, and while, as one authority expresses it, they have added somewhat to the discomforts of an already uncomfortable war, they have not proved of any great practical value. It is reported that one or two small detachments, surprised by them when they were first used, were attacked and captured while temporarily blinded, but the troops were quickly provided with goggles whose rims were backed with spongy rubber cushions, fitting air-tight to the face, and completely protecting against the "weepers."

The last group of the gases, the irritants or blisters, while fortunately not dangerous to either life or eyesight if the mask is worn, are the most practically troublesome and annoying of the whole lot,

and far the most heavily used. It is estimated that in some of the recent preliminary bombardments, from a third to a half of the shells fired of all descriptions, were gas-shells or mustard-gas.

This last is the gas masterpiece of the General Staff and is a peculiarly German vapor, being sneaky because it is invisible and almost odorless, murderous to the wounded because it will hang about for days or even weeks in shell-holes or abandoned dug-outs just waiting for them to fall into it, and peculiarly vicious and painful in its attack upon the skin of the body, which it burns like liquid fire or scalding steam. It has nothing to do with mustard, but is a synthetic or specially constructed compound known in chemical circles as chloro-ethyl sulphide.

The only warning given by this gas is a faint mustard-like smell and a slightly sweetish, pungent taste in the mouth, instantly recognized by those who have once experienced it. In the beginning it caused quite a number of deaths because the troops, not being familiar with the odor, did not put on their gas-masks until it was too late, and when you breathe mustard gas deep into your lungs the consequences are much the same as when you breathe in flame in a burning building. It literally burns the linings out of your bronchial tubes and you have about a fifty-fifty chance of dying of septic pneumonia a week or ten days later.

I happened to see scores of these mustard-gas pneumonia cases in the Allied Base Hospitals, last autumn, when the beastly stuff was first used, and hundreds of the skin burns, and they were a pitiful sight. One great group of hospitals alone had had five thousand cases and nearly one thousand deaths. The worse cases of all were those of wounded who had fallen into holes full of this treacherous gas and who had to lie there for hours, and of one half company of soldiers, who had gone back to their dug-out to rest, not knowing that it had been shelled and filled with mustard-gas in their absence. They actually lay down in their bunks and went to sleep without detecting the stuff, and woke up a couple of hours later, literally burning alive, both inside and out, and although they were able to struggle up to the surface and get taken to the hospital, over half of them died.

But this was only in the surprise period, when the troops were unfamiliar with the engaging little peculiarities of mustard-gas, and the report was spread up and down the trenches that it would go right through the gas-masks. As soon as they were reassured that the mask was a complete protection to both lungs and eyes, and were warned of its lack of odor and its habit of lying in shell-holes and in dug-outs unless they were thoroughly fanned or sprayed out before being occupied, it ceased to be seriously dangerous.

At that time we could tell gas-shells from ordinary shells by the fact that they made but a feeble report, being loaded only with just enough explosive to scatter their poisonous cloud abroad through the air. So that the veteran soldier, as soon as he noticed that many of the shells in his neighborhood seemed to be "duds," or failed to explode properly, promptly suspected gas-shells and reached for his mask. But the German Gas Board quickly "caught on" and remedied that little defect by increasing the charge of explosive, so as to make a gas-shell as loud as an ordinary shell. Hence, the troops now, as soon as any serious bombardment commences, put on their gas-masks as a matter of routine. This, of course, does not protect them against the burning effect of the gas upon their bodies. But it has been found that, unless they are actually drenched with the gas — or, more accurately, sprayed, because mustard-gas is not a gas, but a liquid — by the bursting of a shell within twenty feet, or lie for some time in a shell-hole or trench-bay or dug-out, which is filled with the gas, it will not soak through their clothing in sufficient amounts to do much harm.

If a mustard-shell bursts actually in a trench, its fumes can be fanned out by vigorous use of boards or paddles, or a sort of wicker fan provided for the purpose; while I was assured that if a soldier gets his clothing saturated by the landing of a gas-shell

within twenty feet and begins to feel the "bite" of the gas on his skin, and can promptly throw off his clothing he will escape with only a few blisters. He has to count himself as a light casualty and go to the rear with the rest of the wounded, and if he does this promptly enough all will be well. His literal "dressing" will not take very long, and he will soon be back on the firing-line again.

The gas cannot attack the surface of the body where it is dry, but only where the skin is moist from perspiration, as under the collar, round the hat-brim, under the arm-pits, etc. Bad as mustard-gas is, if a soldier puts on his gas-mask promptly and counts himself as a light casualty whenever a gas-shell explodes within twenty feet of him, he will side-step nine tenths of its dangers. Its one redeeming feature is that the burns of the skin produced by it, though fierce and painful, are quite superficial, and although very slow in healing, because the gas seems to poison as well as to burn, they leave no scars; and even the eyes which have been caught unprotected by goggles are not permanently damaged by it. As an illustration of the heavy, clinging character of this gas, nurses undressing wounded men whose clothing has been soaked with it will get their fingers burnt unless they wear rubber gloves.

As for the treatment of gas-poisonings, far and away the best cure is prevention and the most po-

tent remedy is a little word of four letters, *m-a-s-k*. By the prompt and vigilant use of the box-mask, not only the fatalities, but severe gassings have been cut down to only a few in a thousand of the troops attacked, for nearly two years past. It was in fact the perfection of the gas-mask and of the allied gas-drill and systems of warning that caused the German Staff practically to abandon the gas-clouds or gas-waves on the Western Front.

The details of this drill have become literally a household word, since so many of us have boys of our own or friends in the training-camps. The young recruit is first trained in putting on the mask snugly and learning to breathe comfortably in it, first at rest, then walking, and finally running, drilling, working, and even playing football. Then comes the "gas-house," where he is dosed with first a mild, and later a strong, concentration of the gas so as to learn confidence in his mask. Finally, with his gas-mask in the "alert" position strung high across his chest, the alarm is sounded, followed thirty seconds later by the "wave." This sounds rather swift, but as the standard time for hustling into a gas-mask is ten seconds from the "alert" and fifteen from the "carry" position, and it has been known to be done in four, there is ample margin.

Every possible precaution is taken, as both English and French officers assured me that sergeants

and corporals have to keep the sharpest lookout upon the files as they first march into the literal "lethal chamber," for in every hundred youngsters there will nearly always be found one or two, who, in spite of all coaching and assurances, are smitten with panic and lose their heads completely at the first whiff of the chlorine and clutch wildly at their masks to tear them off, and only the promptest seizing and hustling instantly neck and crop out of doors will save them from serious strangling! And I don't mind confessing a deep sympathy with and for those poor, terror-crazed young rookies.

But supposing some accident had happened, that a man has been wounded before the alarm was sounded, or a shell fragment has torn his gas-mask; even then the chances are ten to one against any serious result. He is promptly seized by his comrades or the stretcher-bearers and an extra mask hustled over his head, or, if none is available, a heavy wet bandage is tied over his mouth and nose, and he is hurried with the wounded to the rear.

The best remedy against chlorine and phosgene is another gas — oxygen — and all Casualty Clearing-Stations and Evacuation Hospitals, and many Advanced Dressing-Stations are equipped with a cylinder of oxygen with a multiple nozzle, so that eight or ten tubes can be attached to it, for the treatment of as many gas victims at once.

A gassed soldier is treated strictly as what the English call a "lier" and the French a "grand blessé" ("heap wounded"), and carried on a stretcher in spite of his indignant protestations that he is perfectly able to walk, because the great danger from phosgene is death by heart failure during exertion an hour or so after the gassing.

Officers who have flatly refused to leave the trenches have been known to fall dead while shouting commands to their men. But if the phosgene-gassed man is kept completely at rest for four or five hours, he is almost entirely safe from this disaster. Unless he is suffering a great deal of distress in breathing, it is considered safer to keep him in the first shelter where there is room for him to lie down comfortably, even at some little risk of shell-fire, rather than put him to the strain of being carried back to the Dressing-Station or Hospital where he can get oxygen.

If much chlorine has been inhaled, nothing relieves the agonized gasping and struggling for breath like oxygen, and I have seen three and four patients at a time lying on cots around the blessed oxygen tank, each sucking away at a tube contentedly, as comfortable as kittens, and on the highroad to recovery. In severe cases of gassing with chlorine, prompt bleeding — the old-fashioned blood-letting, or venesection — often gives great relief, because it drains, as it were, the dreadful edema or watery swelling

of the tissues of the lungs, produced by chlorine gas, which is the chief cause of suffocation and death.

This was very popular at one time in both the German and the French Army, but it has now been abandoned or only used where oxygen cannot be had, because it does not relieve any more rapidly than oxygen does, and has no curative effect at all, the distress coming back again in the course of an hour or two. Another extremely prompt and effective remedy, which is at present a military secret, has recently been worked out by our own American Gas Investigation Board at New Haven.

Altogether, what with rest, oxygen, and blood-letting in dire emergencies, the death-rate from gas poisoning has been cut down to less than ten per cent — in some hospitals that I visited to less than five per cent. So that the word “gassed” no longer fills us with the sense of helpless and hopeless horror which the sight of those first green-face specters of men, gasping and frothing at the mouth in mortal agony in the earlier gas-clouds, had indelibly impressed upon our minds.

My most courteous guide and conductor through the front-line hospitals of one of the English armies happened to be the surgeon into whose Dressing-Station behind Ypres were carried some forty of the victims of the first gas-attack. And he said that never until his dying day could he forget that scene, the

distorted countenances and sobbing agony of the poor fellows, and his own utter sense of helplessness to do anything to relieve them.

Fortunately, however, those dreadful scenes did not last long, and since the introduction of the mask, I have not been able to find any hospital along the whole of both the British and French Fronts which had had a mortality of more than twenty per cent in its gas cases even before the use of oxygen.

But what of those who recover from gassing? How permanently are they damaged and what is their future outlook? Here again I was agreeably surprised, because I had heard many and widespread rumors, not only among the public, but in the medical profession, to the effect that any man who had once been badly gassed was practically ruined for life and never fit for active duty again. On the contrary, I found that the great majority, probably at least seventy per cent, including, of course, the lighter cases, recovered as completely as they would have done from an ordinary pneumonia or a bronchitis, and were back again on the firing-line, apparently as well as ever, in a month or six weeks.

A considerable minority, however, perhaps a fifth, were left in a wheezy, asthmatic, chronic bronchitic condition which lasted for several months, and in some cases a year or more, and which temporarily unfitted them for active service, but even most of

these seemed to clear up finally and recover almost completely. A small number seemed to be rendered permanently asthmatic, particularly among men over forty.

As to the widespread popular belief that gassing was peculiarly liable to be followed by tuberculosis, and that we should need large hospitals for the accommodation of the consumptive soldiers rendered tubercular by gas, I could find no foundation for it, even after visiting not merely the Field and Base Hospitals, but a number of the special sanatoria and hospitals for consumptive soldiers in both France and Italy; except that in about a dozen cases, men who were known to have been tuberculous before they entered the army, and had the disease in a resting stage, suffered a relapse after being gassed.

It is, of course, too early to speak positively about two such extremely chronic diseases as consumption and bronchial asthma, but so far apparently not more than one or two per cent of those gassed have developed either of these diseases.

For mustard-gas, if inhaled deeply and long enough, there is no effective treatment, because no known drug will supply the bronchial tubes and air passages with new linings to take the place of the old ones which have been literally burnt out. But one half to two thirds even of these cases fight their way through to recovery from their septic pneumonia,

and they are now quite few in number, since the troops have learned to put on their gas-masks at the first suspicion of gas-shells in a bombardment.

Altogether, what with the box-masks, gas-drills, a perfect system of gas-alarms by means of great Strombos horns driven by compressed air, fans and paddles of various sorts for driving the gas out of the trenches, and the Vermorel anti-gas spray, which cleans the air of trenches and dug-outs by precipitating chlorine with a chemical spray, the percentage of deaths, or of even serious poisonings or burnings, by gas has been reduced to a very small one. The great German gas drive has been completely checked, if not actually checkmated.

XI

THE DRINKING-WATER OF THE SOLDIER

WATER, in spite of its proverbial "weakness" and instability, is one of the chief sinews of war, not only in the fundamental sense that everything about us which is really alive swims under water, and dryness spells death — "dusty death" as Macbeth calls it — but also from three purely military and local points of view: First, the soldier needs water to fight on — a regiment in action without water becomes useless almost as quickly as one without ammunition. Second, because the wounded are desperately in need of water, on account of the drainage of their bodies by loss of blood. Hence, the apparent paradox that the wounded who have to lie out on the field in rain and even in snow suffer far less and keep in better condition than those who fall in dry hot weather. Numerous instances are on record in this war of men who have fallen wounded in some remote or hidden shell-crater and have lain there in rain, sleet, and even snow for from five to seven days, and have then been picked up not merely alive, but in condition to make a rapid recovery. A man will stand a lot of cold and a lot of soaking, but he bears drying very badly. One instance re-

lated to me by a surgeon friend to whose hospital the wounded man was brought establishes a new world's record in human endurance. He had lain out in a shell-hole in No Man's Land, or rather behind the first German line, for *fifty-one days* in wet weather with a shattered leg, drinking the rain water which pooled in the shell-hole and living on the "iron rations" in the knapsacks of the dead bodies around it within the area over which he could drag himself on his hands and one knee during the nights! Thirdly, because water is one of the chief means of conveyance and spread of the three great camp plagues or army fevers, typhoid, cholera, and dysentery. These three plagues in historic times followed the colors as surely as the vultures did, because the very first thing which an army without modern first-class sanitary service does in the field is to foul its own water-supply.

Kipling has vividly expressed the vital necessity of water to the fighting man in his famous ballad of "Gunga Din": —

"You may talk of gin an' beer, w'en you're quartered safe
back here,
With your little penny fights and Aldershot it,
W'en it comes to bloody slaughter, you will do your work
on water,
An' you 'll lick the bloomin' boots of 'im that 's got it."

The water-supply for an army in the field is an extremely difficult and perplexing problem, as vexing

as it is vital. It was on account of its desperate and apparently hopeless struggles with the problems of water-supply, or, what is simply another way of putting it, sewage-disposal, that sanitation came to be regarded as one of the dismal sciences.

Even leaving out of count altogether such trivial details as purity and wholesomeness, it is often under modern war conditions difficult to get a sufficient amount of just plain wetness for an army or a unit. This at first sight seems incredible, because there appear to be rivers and streams almost everywhere rambling over the face of the planet, and where there are no rivers there are ponds and wells.

But unfortunately modern armies have to live along or near trenches, and trenches cannot always be dug in river valleys; in fact, they very seldom can, on account of difficulties of drainage and flooding; hence the Front usually runs along the tops of ridges. Along those ridges there may be scattered a few villages, each with its wells or springs, and between them an occasional well or dew pond.

But when you remember that the soldier population of the Western Front is over ten thousand to the mile, then the trifling supply sufficient for the rural population becomes a mere drop in the bucket. Especially in view of the fact that that rural population never drinks water when it can possibly help it, and considers itself punctilious to the verge of ab-

surdity if it takes a bath once a year. This is no mere figure of speech; there are scores of old men in these villages who cannot remember the date of their last bath, and I have seen a copy of a prospectus of a famous boys' school, about thirty years ago, in one of the chief Continental cities, in which a full section is devoted to the proud announcement that parents may feel confident that the health of their children will be most strictly guarded, for they will receive regularly one foot-bath each week and one full bath ("grand bain") each month!

In mountainous regions like most of the Italian Front, and particularly the Carso, all the water for the troops, not only in the trenches, but also in the support and part of the reserve lines, has to be hauled from two to five miles in tanks or water-carts or huge casks, and if the Austrian gunners can succeed in spotting the row of casks or concrete tank in which the water-supply for the first-line is stored upon the top of the mountain, and drop a batch of shells into it, they are as pleased as if they had blown up an ammunition dump.

Even along such moderate elevations as the ridges of the Somme, my Army doctor friends have assured me that both armies have found it a matter of great difficulty and watchfulness to secure an adequate supply of water for the armies of the first and second lines.

In some cases it has been necessary to go to the trouble and expense of laying pipe-lines from some mountain lake or stream above danger of contamination, or deep wells, three to six miles away, just as if one were supplying a city. Several of the sections of both the English and the Italian Fronts have been supplied in this way and given an abundance of pure cold water which needs neither filtering, boiling, nor chlorinating, which is an unspeakable boon in war-time.

The majority of army areas, however, have to draw their supplies from some river or lake or pond. Now, a river is a lovely thing to look at, "composes" beautifully in a picture, is delightful to boat or canoe on, refreshing — sometimes — to swim in, but to drink out of —! Rivers would be all right for drinking-water if it were not for the habit which villages have of coming down and roosting on their banks. We have all heard of the pious citation in proof of the beneficent and guiding interest of Providence in human affairs, in that great rivers always run by large towns even if they have to go miles out of their way to do it: which, from a sanitary point of view, is very nice for the towns, but very bad for the rivers. In short, a running stream in anything like a thickly settled or civilized country is little better than a common sewer. And wells dug along its banks or in the bottom lands of its valley are little better. It is almost

incredible to any one, who has not made a special study of water-supplies, how swift and certain is this contamination of wells, ponds, and rivers.

Our American Army camps in the foothills and plateaus of the Rocky Mountains region used to be greatly troubled with a serious fever known as mountain fever. It had many of the characteristics of typhoid, including a fairly high death-rate, but everybody scouted the idea of water-pollution in those wild, clean mountain ranges. But one or two outbreaks were clearly traced by Army surgeons of an inquiring turn of mind to contamination by Indian encampments farther up; the water was boiled or chlorinated and the disease disappeared.

A more modern instance was furnished in amusing fashion only a few weeks ago on the Western Front. A division of our Allied troops was billeted in a certain village. They built their sinks and latrines according to sanitary regulations, and ran them into deep pits dug in the soil, of the cesspool type, and to discourage flies treated them daily with a disinfectant solution containing creosote. Within three or four days the village fathers waited upon the commanding officer with the bitter complaint that the creosote was utterly ruining the taste of the drinking-water in their favorite wells! They had become quite accustomed to and unconscious of the taste of sewage, but the flavor of creosote was more than they could stand.

While the purification of water in the field by chlorine is simplicity itself — just dip up the water, add the chlorine, shake, and allow to settle — its carrying-out on any considerable scale in the field requires a little apparatus. The question of the proper proportions of chlorine is readily met by the provision of boxes or cases of glass tubes each containing enough bleaching powder to sterilize safely five gallons, ten gallons, or twenty gallons of water, as may be needed.

Then comes the question of a container for the water, for, although it is quite possible to sterilize it by the pitcherful or the bucketful — in fact gallon and even quart tubes are provided for the use of travelers or small parties — in camps, of course, it is advisable to treat sufficient for a day's supply at once.

For work in the open field and temporary camps, the container used by the United States Army is simplest, cheapest, and most easily portable. This consists of a stout, waterproof canvas bag capable of holding thirty gallons, with three nickel-plated spring-action faucets opening from its lower part, and three stout, white-metal rings set round its upper border or mouth. This is slung on a tripod of poles by cords from the rings, at such a height as to bring the faucets about four feet above the ground, has a canvas flap or cover, and will supply drinking-water for the night and morning for a hundred men.

It takes only a few minutes to fill and sling, and thirty minutes later there is an abundant supply of pure drinking-water, without unpleasant taste, in an extremely accessible and convenient form. When the bag is empty, it collapses, and can be folded with its ropes into a small, compact bundle, so that it is admirably adapted for cavalry campaigning and one-night camps.

The next simplest method, and the one most commonly in use on the Italian and French Fronts, is that of a couple of large casks, or, where circumstances permit, of specially constructed tanks placed side by side. Into one of these the raw water is pumped from the stream or pond or well, treated with the bleaching powder, stirred well, and allowed to settle. When all the sediment has subsided, the water is siphoned over into the other tank or cask, from which it is drawn directly for use or piped over the camp.

Where it is possible to use a permanent supply of water with a system of distributing-pipes, the chlorination is quite simple; all that is needed being an additional basin just before the water goes into its permanent storage or distribution reservoir, in which the water can be held for an hour while the proper proportion of bleaching powder is added to it.

Indeed, it may be of interest to remark incidentally, especially as the fact is not generally known, that

so perfect is the protection afforded by bleaching powder, and so many and incalculable are the dangers which threaten a great city's water-supply, that many of our large American cities — New York, Chicago, Cleveland, and Toronto, for instance — chlorinate their water before passing it into the mains. So that many who read this know by practical experience how completely free from disagreeable taste properly chlorinated water is.

It is on the English Front that the most thorough and carefully thought-out system of water-supply for the troops is in operation, though that of some sections of the Italian Front, which have piped in water from an available mountain stream, is extremely good. In a very considerable number of the English Army areas, they have either cleaned out and utilized old reservoirs or constructed new ones, and laid regular water-mains down behind their lines, with branch pipe-systems to supply the different camps.

Some of these reservoirs are filled by pumping from a stream or lake, or large marshy pool preserved for duck-shooting purposes, known by the French as an "étang," and then filtering and chlorinating the water. Some of this water is piped from quite a considerable distance, of which I had a rather amusing illustration at one point on the English lines "somewhere in France." The Chief Sanitary Inspector for the Army area, a most enthusiastic and competent

Staff officer who was courteously showing me the sanitary arrangements of the zone, informed me with a chuckle of natural pride that the water-supply of something like three divisions of the British Army was being drawn from a small lake a mile or more inside the German lines, which was rather a good joke on Fritz and his wonderful, superhumanly omniscient spy system.

My friend the Major said that it only balanced up matters, anyway, because the Germans had carefully selected the high ground for their trenches in such a way that they were not only able to drain them completely without pumping, but to pour their drainage into the English trenches on the lower ground: which was certainly adding insult to injury. Needless to say, the water from this conduit was thoroughly sterilized and filtered, as well as frequently examined for possible poisoning.

Incidentally, as a specimen of the spirit with which sanitary measures are carried out in the English Army, this same Inspector, after a great battle and an advance of nearly three miles, had drinking-water piped on to the battle-field itself for the use of the thirsty troops within five hours of the time that they had established themselves in their new positions! I strongly suspect (though upon that point I have no positive information) that he utilized this secret conduit by tapping it higher up toward its source,



A PATIENT COMING ON BOARD A HOSPITAL BARGE

but even that would involve the laying of something like a mile and a half of pipes over an extremely broken and irregular surface, and certainly does not detract in any way from the remarkable credit of the performance.

Where circumstances do not permit of the installing of a pipe supply of water, the English sanitarians have devised one of the most perfect machines for transforming any kind of water into a clear, safe, drinkable beverage that I have ever seen. It is based upon the chlorination method, and consists of a group of tanks with an engine and purifying system mounted upon a large motor truck. The engine of the truck provides the necessary power and heat.

The machine pumps its own water from a stream or well or pond, drives it through a mechanical filter under pressure, precipitates it with iron alum, and again filters it under pressure, thus removing entirely all visible impurities. Then it passes it into a large tank where the chlorine solution is injected into it, and after a brief period of delay, the now pure, clear, and absolutely sterile water passes out through the discharge pipes, into casks, reservoirs, or temporary pipelines. By an ingenious arrangement of tubes with glass "windows" or eyelets in them, samples of the water are brought right under the eye of the operating engineer in the cab of the motor at every stage of the process, and by stop-cocks specimens are drawn off

and tested, first chemically and at the last bacteriologically, so as to see that the process is working to perfection at every stage.

An equally ingenious series of stops and valves gives the engineer perfect control of the different chemical and sterilizing processes, so that he can increase or diminish the amount of precipitant (alum), the pressure of the filter, and the proportion of chlorine, merely by the pressure of a finger.

The result is so absolutely perfect as to give one almost an uncanny sense of magic. The first machine which I saw was doing a special "stunt" test. It had dropped its intake pipe into a pool of filthy, pea-soup-colored, stagnant water, covered with green scum which had collected between two refuse heaps at the back of an abandoned factory. From its discharge pipe was flowing into a large tank a steady stream of clear, sparkling, nice-tasting water. To look at the water in the filthy pool and the clear stream rushing and sparkling into the tank, gave one a positive shock.

The motor weighs about three and a half tons, travels by its own power anywhere, can get under way inside of thirty minutes, and can transform the vilest soup into pure drinking-water at the rate of about a thousand gallons an hour. That is to say, one machine is capable of supplying an army of ten thousand men.

XII

GUARDING THE HEALTH OF OUR FIRST AMERICAN TROOPS IN FRANCE

A MORE quietly charming and peacefully picturesque country than that in which our American Expeditionary Force was first temporarily quartered could hardly be imagined: a gently rolling country of hill and valley, rising gradually in long, broad-crested waves to join the western mountains; the tops of the ridges for the most part bare, thinly covered with soil bearing dwarf scrub or wiry grass.

The towns and villages lie sheltered in the valleys on the rich but narrow green bottom lands along the swift streams. The slopes leading up to the long, bare hill ridges, and the deep little cross-valleys running down from them, are clothed with woods. The effect is quaintly picturesque and ribbon-like, as if some skilled gardener had laid out the country in broad, contrasting bands: a narrow band of bright green down the bottoms of the valleys, picked out with red roof and gray wall and silver gleams of river; a broad band of dusky green of trees and copses along the slopes; and another band of gray and silver green along the bare half-alpine tops of the ridges.

To make the gay formal garden effect more com-

plete, the moors above are splashed with purple streaks of heather, and the stubbles below are one blush of pink, from sheets of a magenta-flowered mint.

It is a land of sheep and cattle and bees, and closely resembles the Joan of Arc country. In fact, that beautiful pitch upon the shoulder of the hill, with the wheat-fields and pastures sweeping away below it and the green shadows of the woods behind, where the Maid saw her first vision and the memorial church is built at Domremy, stands on the slopes of just such a valley as is repeated a dozen times in our America in France.

The Maid is gone, and her visions have come true beyond her wildest dreams, but her sheep still remain unchanged. You can see them being driven down by scores and hundreds in the sunset light every evening, by the same old sheep paths and winding lanes, from the moorland pastures above to their folds under the same roof as their shepherd in the village below. And their shepherds look ancient and time-worn and primitive enough to have known "La Pucelle" when she was an infant in arms.

History repeats itself in a rather unexpected way sometimes, and our troops almost precisely duplicate the movements of the Maid and her sheep, as they march up to the moorland levels every morning, only to train and drill instead of cropping grass and

seeing visions. The fields at the bottom of the valley are too narrow and crowded and the land too valuable to be torn up with trenches and covered with barbed-wire entanglements. So most of our regiments march up the hill slopes for a mile and a half to three miles every morning — which is very good for their wind — to their training fields and drill trenches, which have been laid out along the broad, rolling summits of the ridges.

Here they march and countermarch and practice complicated maneuvers of attack, charge with the bayonet, jab viciously downward at dummy Germans in the first trench as they leap over it, and jump fiercely down into the second one and proceed to "mop up" imaginary Boches. This, with rifle and machine-gun practice on the ranges, with sham fights against the splendid veteran "Chasseurs á pied" and other French troops which have been sent down to drill with and against them, fills up the time busily until the clatter and groaning of the chuck wagons scrambling up with their mule teams from the valley below announce the hour of grub.

Each man draws his mess-tin and dipperful, and the squads squat down in long rows on the ground, officers and men alike, and fall to eagerly. Then, after twenty minutes of luxurious basking with slackened belts, the bugles sound, up they get, and at it again vigorously for two more hours, and then

line up for the march downhill and into billets in the village below.

It is a busy, vigorous, happy life in the open air and the men take to it like ducks to water. And there is a good deal of water for them to take to, for their first "baptism of fire" was three weeks of almost incessant, chilly, pelting autumn rain, which falling on a clay-loam soil gave them a real foretaste of the famous mud of the trenches. But this did not stop or dash them in the slightest — they drilled and marched, and charged with the bayonet and counter-attacked, and jumped down into trenches half full of muddy water, all in the pouring rain, until they got so hard and "self-heating" that they positively enjoyed the downpour — or, at least, they said so.

The men are fairly bursting the buttons off their tunics, not below the waist, but across the chest, and not a few of them can actually hardly get into coats which were a comfortable fit when they joined the Army three months ago. They are getting as hard as nails and as waterproof as trout. And so splendidly are they fed and so superbly sanitized and protected against diseases of all sorts, that their sickness rate is barely one and three tenths per cent, as compared with two and a half in barracks in time of peace.

The first and most vital problem — that of the food-supply — has been solved by the company or double company messes with their camp-stoves and

semi-underground ovens under the big mess-tents which are pitched at convenient corners or open spaces along the village streets, with the mess-tables alongside under similar awnings or out in the open.

Many of the men take their mess-tins and pannikins full and find seats for themselves on carts and baskets and doorsteps and the platform in front of the Mairie and eat their rations picnic-fashion. This forms a great source of interest and amusement for the small fry of the village, who have an intense curiosity about the new and strange food of these huge, friendly, good-natured allies of theirs, particularly the corn-syrup and the dried-fruit pies and the doughnuts and the chocolate. Though they tasted them in fear and trembling at first, they now highly approve of these novelties. And although the natural politeness and good manners of all French children will not allow the older ones to "hang round" at meal-times, except by special invitation from personal friends to whom they have been properly introduced, the toddlers and three- and four-year-olds have no such false delicacy.

It is a pretty sight to see a great strapping young six-footer from Texas, with a plump, round-eyed youngster perched on his knee, sampling eagerly each of the successive "courses." With the older children the language question presents some difficulties, though they make the very best of teachers,

so that that quickly disappears, but with the younger ones the universal sign language and lip-reading are quite sufficient.

I was greatly amused by one roly-poly youngster, pretty nearly as broad as he was high, who sat on the pavement, with his short fat legs sticking straight out in front of him, right alongside of his soldier friend. He did not waste a single word or sound or motion while I was watching him, but whenever he needed a fresh supply, he simply tipped up his beak and opened it wide, like a young robin in the nest. The moment he was loaded he closed it again and as soon as the gangway was cleared, repeated the process, without the loss of a moment or a breath.

Nowhere upon all the various fronts which I have visited did I find children and soldiers on such friendly and intimate terms. In every village that our military auto passed through the children would line up and salute, and every group that we passed on the road would wave their hands to us and seemed perfectly delighted when we saluted in return. This is due in part, I think, to the natural kindliness and fondness of children of our American boys, and in part to their homesickness. Grown-ups may differ in all sorts of degrees, language, dress, appearance, behavior, but children, thank Heaven, are alike the world over, and seem like a little bit of home to every wanderer.

Wherever you go in the American Army area — whether you wear uniform or only just look like an American — you are saluted on every hand and greeted with bows and smiles of the most genuine friendliness. They make you feel that they think the mere fact that you are an American insures that you are a friendly, generous, and trustworthy sort of person, and it will be worth a lot of trouble on our part to live up to that reputation. If it had been carried out by orders from Headquarters from motives of deepest laid diplomacy, it could not have been happier in its results. The same cordial respect and liking exists along the English Front, but it is not shown quite so openly on account of the wider differences between the French and the English temperaments. If an Englishman likes you, he is more than half ashamed to let you suspect it, and nothing embarrasses him more keenly than any open manifestation of regard on your part. This utterly puzzles the French, who were even a little chilled at first by the triste and serious expression of our American soldiers. But it did not take them long to get past that barrier, and within a few days they were on the very best of terms.

In the language of the day, our American troops have "made a hit," and a most emphatic one, with all ages, sexes, and sorts of the French people.

But this picturesque, picnic style of commissariat

for the troops will not last much longer. Proper movable kitchens, great boilers and ovens and cooking-ranges combined, mounted on wheels and drawn by horses or motors, have been adopted by the Army Board of Washington and will be supplied to the troops in due time. These wheeled army kitchens, called by the Germans "goulash-cannonen" and by the French "mitrailleuses à la batata," are extremely popular with the other armies, and are the literal cook-shop on wheels, with balancing and anti-splash arrangements which allow dinners to be cooked en route for regiments on the march. So that whenever the halt is called, the tired men find piping hot stews and potatoes and coffee all ready for them.

On the busy roads up near the Front, when you meet a relief regiment changing posts, after the long files of blue-coated and blue-helmeted "Chasseurs à pied" or "Alpins" have poured past, come the transport wagons by the score, piles of bedding and blankets and kit, and then nobly protecting the rear roll the great "goulash-cannonen," with smoke pouring out of their chimneys and a most appetizing odor of savory stew floating up from the tops of their cauldrons.

They are the stomach-warmers of the army, and the stomach lies very close to the heart. When camp is reached, they are halted in a convenient spot, a ridge-pole is run up over them, a big tarpaulin

stretched over that, and there you have a dry, warm, comfortable kitchen ready to cook anything that can be cooked in any hotel or restaurant in the land.

When these have been installed in the villages and lumber to build comfortable mess-halls secured, which the men can dine in during the day and read and write letters and smoke in at night, — for neither lights nor smoking can be allowed in billets, — the army will be provisioned for any length or kind of campaign.

The water problem has been solved by the use of the canvas thirty-gallon bags suspended on tripods which are to be seen dotted about every encampment. They, however, are only suited for the autumn maneuvers or Indian-chasing style of war, and will soon be replaced by proper double tanks or modern motor pumps and sterilizers combined, of the English fashion.

The bags are portable and quickly set up, but for permanent use they have the very serious drawback of having the drinking-water drawn from the same vessel in which it was chlorinated. As there is no telling by the look of the water whether chlorination is complete or not, this means that unless some orderly stands guard over the bag from the time the bleaching powder is put in until the chlorine has been completely neutralized, the first man who comes up to take a drink out of it will get a mouthful of

bleaching powder plus any dregs and sediment which may have settled to the bottom in the process. Which gives him a strong prejudice against any sort of chlorinated or otherwise "doped" drinking-water for the rest of that campaign. He will drink from any pump or well or stream that he can come across sooner than resort again to that "chemical" bag.

While water which has been treated with bleaching powder is usually quite tasteless and good to drink, in from three quarters of an hour to an hour, it is much better and safer to let it stand overnight. So that all permanent plants for the chlorination of drinking-water consist of two tanks or large casks side by side, in order that the water may be treated and allowed to settle completely in the one, and then siphoned over into the other for use, leaving six inches of water and all the dregs in the bottom of the first container.

Unless this is done, it is difficult to get the wary and suspicious dough-boy into the habit of drinking "bleached" water. Our Army medical officers are so zealous and vigilant that they succeeded in making the soldier-boys take most of their uncooked fluid nutriment from the bleaching bags, as is evidenced by the almost complete absence of diarrhoea and other intestinal disturbances in the camps. And as nine tenths of all the specimens of water from wells, fountains, or streams examined in the zone have been

found heavily loaded with colon bacilli, which means contamination with sewage, this is a real triumph for their enthusiasm and efficiency.

But it is a constant and wearing strain upon their vigilance, which is unnecessary and might be entirely avoided by the installation of proper tanks and pipe-lines supplying each barrack in the camps. So direct and striking is the contamination of most of the native drinking-water in the army zone, that disinfectants used in our latrines give a strong flavor of creosote within a few days to all the wells and fountains in their neighborhood.

The third great sanitary requisite for the health of an army, latrines and sewage disposal, presents the greatest difficulties in the way of its solution. As none of the villages occupied by our troops has any pipe-line system of water-supply, the only methods of waste disposal possible are by the simple pit or trench latrines and the running of sewage water in open ditches directly into the streams.

The soil of the valleys in which the villages lie is simply underlain with sheets of water, so that wastes disposed of in pits in the soil promptly find their way into all the other deeper pits called wells within a hundred or a hundred and fifty yards around them. This makes the pit or trench type of latrine distinctly undesirable from every point of view.

The Sanitary Corps of the Army is keenly alive

to the difficulties of the situation in which it finds itself, and the pail and incinerator system of the Italian and English camps has been applied for to the authorities and will probably soon be granted.

In this method, the wastes in the latrines are kept entirely above ground in large pails containing small quantities of disinfectant fluid. These are emptied twice a day directly into a special type of incinerator, in which, by a skillful arrangement of draughts, they can be burnt completely without either smoke or odor, at an expense of only about one hundred pounds of coal per day for each five hundred men.

This is the ideal method of camp sanitation, for it protects the soil from any kind of contamination, and what is even more important practically, it absolutely prevents that busy middleman of the pestilences, the fly, from carrying infection from one case to another. Every other known system for the disposal of wastes simply means their reappearance in somebody else's food or drinking-water sooner or later. Pails and the materials for building the incinerators have been promised, and this admirable system will doubtless soon be installed in our Army camps.

The fourth and last great sanitary requirement, shelter, has been temporarily solved in our American Army zone by the use of billets. This means that the

men are housed in squads of from ten to twenty in barns, haylofts, granaries, stables, the second story of hen-roosts, and sheep-pens. After these have been thoroughly cleaned of the dust, cobwebs, and other deposits of past centuries, their entrances white-washed, and the inhabitants gently persuaded to remove as many as possible of their cows, horses, goats, sheep, and poultry from the ground floor of the sleeping-lofts, they become fairly wholesome and quite tolerable temporary accommodation for the use of troops.

The thing that causes this curious congestion of live-stock under the family roof, and also makes it very difficult to relieve, is that rural France is still constructed and organized on lines laid down in the tenth and twelfth centuries. Then the forests were full of wolves, and the roads were infested by thieves, brigands, and members of the nobility, and crops, live-stock, or other movable property left out of doors after dusk had about as much chance of surviving till morning as the proverbial snowflake in Hades.

Consequently the French peasant, who has at least one of the attributes ascribed to his Bourbon kings, that he forgets nothing, has been so schooled by tens of centuries of bitter experience that he would no more dream of going to sleep at night without every one of his precious animals under the same roof as himself, where he can hear every noise they make

during the night and go to their assistance, than he would of leaving one of his children out in the street.

This intimate and affectionate domiciliary association has certain disadvantages — to the animals; and one of the bitterest complaints of misbehavior on the part of our troops, lodged with the Provost-Marshal in a certain village in the American zone, was that of an indignant old lady who came in to complain volubly through the interpreter that the troops billeted upon her talked so loud and so late at night that they kept her sheep and her rabbits awake!

So ingrained has this instinct become, of housing all the peasant's belongings under the same roof at night, that when it was politely and gently suggested by the American officers of the day that the furred and woolly and feathered pets should be moved on to the barns, they were met by the simple, staggering objection that there were no barns. Anything approaching that character in the village was simply an annex of the house, or the house an annex of it, while in the fields around the village and in the open country there was not so much as a shack that would shelter a dozen chickens.

This utter absence of every kind and sort of building in the fields, outside of the closely packed streets of the villages, is what gives a curiously half-wild, prairie-like, picturesque appearance to the

French country. However, after several conferences, out-buildings and sheds of different descriptions as remote as twenty or thirty yards from the parental roof were discovered, to which the dear creatures could be temporarily removed and yet visited once or twice during the night in order to keep them from dying of lonesomeness and a sense of neglect.

Another small international complication that arose was that as soon as the wheat and oats were harvested, the peasants of some of the homesteads in which our troops were lodged insisted upon filling all the space except that actually occupied by the cots of our men, up to the roof with stacks and walls of sheaves. But the O.C. in that village was a born manager of men. He discovered in one of the barns a little one-horse threshing-machine, borrowed a horse from the transport lines, and called for volunteers. A dozen soldier boys who had been raised on farms responded promptly, and in five or six days' time the "gang" made the tour of the village and threshed out their whole small grain crop. This work not only made room for their sleeping quarters, but also raised them highly in the esteem of the community.

All sorts of extraordinary and unheard-of accessories are found necessary in modern war, but this is the first time that a threshing-machine has been placed in the list of articles available for military purposes.

When cleared of their animal boarders and cleaned and whitewashed, these billets make dry, commodious, and well ventilated, though rather dusty, quarters for troops in summer and fall. They have, however, the drawback that it would be very dangerous to have lights of any description in them at night, as the buildings are literal tinder-boxes which a spark will convert into a veritable fire-trap; especially as many of the loft and haymow sleeping-places of the men are reached only by rickety ladders of rough poles.

Also, that they are almost impossible to heat or even dry out in winter-time, partly on account of their literally barn-like size and draughtiness, partly because many of them have no chimneys passing through or near them. One energetic young regimental surgeon had succeeded in partially solving this last difficulty by refusing to accept any quarters for billets in his particular village which had not a chimney running up one or other of their walls, into which stove-holes could be cut.

As he had a good village and a small detachment, he succeeded in getting the sort of quarters he wanted by firmly sticking to it, but all billeting officers are not so fortunately situated — nor so resourceful and determined.

It was expected that before the seriously cold weather sets in, supplies of lumber will have been

secured sufficient to build comfortable wooden barracks with double walls, stoves, and real windows, for the housing of the troops after the manner of the French and English camps. Lumber is another of the peaceful and inoffensive articles which has suddenly found itself contraband of war in this struggle.

So far has the demand outrun the ordinary supply that both the English and the French Army authorities have found it necessary to organize gangs of lumbermen, picked out of the troops, and supply them with portable sawmills and set them to work in the woods and forests in or near the army zone.

The modern army devours lumber like the locusts do growing crops, for barracks, for hospital wards, for headquarters and office buildings, for storage sheds, for railway platforms, for sidewalks, for the walls and roofs of galleries and mines, for dug-outs and underground shelters, for trench walls, and for temporary roads over boggy places, corduroy fashion, to bring up the priceless guns.

Gangs of lumberjacks have already been organized in the American zone, and sawmills ordered, and as soon as they arrive the ancient woodlands of France will begin to suffer, to furnish the means to protect her soil from the invader. Don Quixote went to war with windmills, but never since his day has any general found it necessary to equip his troops with sawmills and threshing-machines.

In the meantime our boys are hard and brown and vigorous, and thanks to the vigilance and skill of our Army Medical Corps, have a sickness rate which is almost what the French call "*une quantité négligeable*." Probably it is just as well for them to start from the ground, as it were, begin with the most primitive and work their way up from tents in Texas to billets in the training zone in France, to the full modern conveniences and sanitary comforts of twentieth-century war.

XIII

NEW FACES FOR OLD AND MAKING A FRACTION EQUAL A WHOLE

NOT the least wonderful of the triumphs of surgical skill in this war have been won over those most dramatic and shocking of shell injuries — wounds of the face and jaws. These, while perhaps not more common than bullet wounds of the same region in former wars, have taken on a far more serious and ghastly character on account of the great size, jaggedness, and terrific momentum of the shell fragments.

A bullet would go completely through the face from side to side, and perhaps break one jaw or put out an eye; but a whizzing, whirling boomerang of a jagged shell splinter disdains such feeble damages as this and will often shear away the whole lower half of the face, leaving the tongue hanging down on the chest, or tear away an eye, all the front of the upper jaw and teeth, and one side of the lower jaw at one swoop.

The worst case of all that I saw was a poor English boy, who had lost completely both eyes, his nose, the front third of his upper jaw, and about a quarter of the front of his lower jaw, including the chin and

lower lip and tip of his tongue. His face when the dressing was taken off was just one succession of bloody craters below another. At first sight the pity seemed to be that he had survived at all. But within six months that poor youngster had been given new fronts to both of his jaws by bone grafts, capable of carrying full plates of artificial teeth so that he could chew perfectly, a new nose, by combined bone and skin grafts, and a new lower lip. Enough of the eyelids were left on one side so that by skillful repairing he was able to wear one glass eye, and a carefully tinted enamel-coated metal plate held in place by a pair of spectacle frames completely covered the gap in his other orbit. So that his artificial face, while far from handsome, was quite presentable enough to allow him to go about his work and appear on the streets or anywhere else in public without attracting special attention or causing any feeling of repulsion in those who met him. The only thing that could not be restored for the poor chap was his sight.

These wizard-like results have been brought about by a combination between the dentist and the surgeon, sometimes in the person of a single individual, a dentist who is also a graduate in medicine and has made a specialty of the surgery of the face and jaws; sometimes by a dentist and a surgeon working in co-operation; one doing the tooth and splint work and the other the surgery proper.

How can the miracle of building new faces in place of old ones be wrought? Suppose that the case is one where a part of the upper jaw and most of the nose and upper lip have been torn away: after the bleeding has been stopped, and the worst of the infection has worked its way out of the great ragged wound and it is beginning to show signs of healing, the remaining teeth in the jaw in front of and behind the gap are tackled by the dentist, cleaned, if necessary filled, and used as the pillars for the attachment of a curved metal or wire splint bridge which temporarily fills in the gap. After the tissues have become somewhat accustomed to this, it is taken out and a regular dental plate carrying the missing number of teeth is fitted in in its place.

This restores the "bite" on that side and the problem of the lip and side of the nose is tackled. This can be met in several ways depending upon the size of the gap. If of moderate size, it can be filled by dissecting up a pear-shaped patch of skin from the temple behind or from the forehead above, carefully planned so that the "stalk" of the pear contains the artery which supplies the patch with blood.

Then the patch is twisted round on its stalk and drawn down or forward to cover the gap and skillfully stitched into place all round its edges. Having still its own blood-supply, it keeps alive until it has grown fast in its new bed and then the stalk of the

pear is cut across and the transplanting of the flap is complete. The gap left in the skin of the forehead or temple can either be closed by sutures or coated over with skin grafts.

If the gap in the lip and nose is too great, or, as unfortunately often happens, the skin of the forehead and temple has also been badly gashed and damaged, then a more radical and complicated method is resorted to. One of the patient's arms is bent and laid across his face in such a position that the inner side of his forearm lies in contact with the damaged side of his face. It is then bandaged firmly in position, the hand being spread out over the top and side of the head, and a flap of skin of the desired size and shape is dissected up from the soft, delicate inner side of the forearm. It is twisted round upon its stalk, stitched into position, and when it has firmly taken root, the stalk is cut across and stitched under as before, and the arm released from its uncomfortable position and set at liberty.

If part of the bridge of the nose and one nostril, say, have been carried away, this flap of skin will need some support. So an incision is made under local anæsthesia over one of the patient's ribs, a little strip of bone just the right size and shape to fill the gap in the bridge of the nose is deftly sawed out of it with a tiny buzz-saw driven by a dental engine slipped into the bed prepared for it underneath the new skin.

of the bridge of the nose, and behold the patient has as Roman or even aquiline a nasal prominence as he ever had before.

Such is the indomitable pluck of the soldier boys that they make all sorts of suggestions to their doctors as to improvements they would like to have made in the shape or height of their noses. If they must have a new nose, they might as well have one to their liking, instead of being doomed to go back to one whose defects they may have been sadly conscious of. They were not consulted about the noses they were born with, but here is their chance to get one that suits them.

If it be part of a lower jaw and chin which has been sheared away, the same methods of wiring or plate splinting together of the teeth on each side of the gap are followed. The lip and chin are restored by flaps taken from the cheek or neck or from the forearm if necessary. But the gap in the jaw needs further attention because to get a really satisfactory result it should be filled by bone if possible. So a little socket is cut with a dental saw in the bone at each end of the gap, a rib is cut down upon as before, and a long enough piece of it carefully sawed and dissected out to fill the gap in the jaw-bone and fit accurately into these sockets cut at each end of the gap: a long-belated revival of the famous operation in the Garden of Eden, but not so utterly surprising, for the

Garden itself has been dragged into this war. Then a careful hunt is made for any strips of periosteum which may be left, the mucous membrane of the mouth is laid open and carefully stitched with these strips over the piece of rib so as to bury it completely. With good luck it will take root in its new position and the patient will again have a good firm lower jaw capable of moving all in one piece, although, of course, he will always have to wear a dental plate carrying teeth corresponding to those which have been lost.

The main element of "luck" in these operations, either for bone splints or other repairs of the jaws, is the question of infection. And curiously enough, while the germs carried in on the shell fragments are bad enough, the surgeons assured me that the most important single factor in getting a good clean heal without suppuration or breaking down was the *condition of the patient's teeth and gums as to cavities, abscesses, etc.*, at the time that he was hit. A clean mouth like a clear conscience is a mighty good thing to go into battle with.

One hardly knows which to admire most highly, the dauntless pluck and cheerful courage of the wounded, who will submit to operation after operation not merely with patience, but with enthusiasm, in the eager hope of getting rid of the haunting fear that they may be left objects of repulsion or dis-

tress to their fellow-men; or the skill, the untiring devotion, and the painstaking enthusiasm of the dentists and surgeons. No trouble is too great, no pains or ingenuity too laborious to rescue these poor fellows from lifelong disfigurement. And their persistent efforts are really astoundingly successful in the end. One might think from the detailed description of the gruesome methods of patching, of flap grafting, and bone grafting used that the result would be at best a mere expressionless mask or a patchwork quilt of skin grafts with a couple of smaller holes for nostrils and a larger one for a mouth.

But nothing of the sort is the case. The surgeons will go the length of a dozen operations with the enthusiastic coöperation of the patient in order to attain not merely a workable mouth, but one which is as nearly as possible of the same shape as the original one, taking particular pains with the curves of the angles. They have devised the most ingenious methods of sewing together the skin edges of the different flaps, carefully beveling off in opposite directions the edges and then burying their tiny sutures completely out of sight under the overhanging of the upper bevel, so that not only no stitch marks, but no scar is visible when healing is complete.

The faces which they construct are really thoroughly lifelike and natural, though, of course, they have a slightly battered and "shop-worn" appearance. They

go at it in the most workmanlike and artistic style, their first request being that the soldier write home for a copy of his latest photograph so that they can have a model to work toward. There is a story — I repeat, a story — told at the Front about a young soldier who had had a terrific wound of the face, and who had been patched up in the most wonderful style. He complained only that when the surgeons wrote home for a copy of his photograph, the family made a mistake and sent one of his next younger brother; and they had made such a faithful copy of their model that he had no end of trouble with their best friends always mistaking them for one another, and even their mother could hardly tell them apart. But I tell this simply as it was told to me.

In the very worst cases, where the loss of tissue has been so tremendous that neither flaps nor bone grafts will fill the gap, another method is followed; a cast is taken of the corresponding parts on the other side of the face. Then from this a thin metal plate is cast and coated with enamel accurately covering the gap and matching the other side. Then this is most carefully painted and tinted by artists who have volunteered for the service, and attached to a pair of spectacle frames which hold it firmly in position. So skillfully and successfully is the tinting and other camouflage done that at a glance one can-

not tell where the edge of the mask leaves off and the living skin of the face around it begins.

These wonderful masks are literally works of art in more senses than one; some of the best-known portrait and other painters of both England and France having volunteered to produce them as a labor of love and patriotic service. If the missing part of the face includes an orbit, a glass eye is inserted in the mask, and then lids, eyelashes, and eyebrows carefully painted round it. In some cases to make the deception still more perfect, real hairs are stuck into the enamel of the mask for eyelashes and eyebrows.

Another new situation which we had to face in this war was a large number of not merely broken, but badly shattered bones. The decent and modest round or pointed bullets of former wars broke bones frequently, but often would go completely through a limb without touching the bone at all, or perhaps just splintering a chip off it, and the wound left by them was a simple, rounded hole through the muscles, from one side of the limb to the other.

But when a whirling, whizzing fragment of shell the size of a stove-lifter or of a flatiron strikes the limb, it gashes a hole that you could lay your whole fist into through all the muscles right down to the bone and shatters that into twenty fragments, and often converts half the limb into a mere mass of

bloody pulp. Every fracture in this war is a huge open wound, with a not merely broken but shattered and splintered bone at the bottom of it; and what is worse, the whole thing from top to bottom reeking with infection.

The old-fashioned wooden or moulded metal splints, which covered from half to two thirds the surface of the limb, were hopelessly unsuited for these cases, where often nearly half the surface of the limb, counting front and back, was occupied by ragged, open wounds, on account of the great difficulty of dressing these wounds, and still more of irrigating them, with the splints and bandages in position. Even our former sheet anchor, a plaster-of-Paris cast, which could be snugly applied to the limb, and then holes, or "windows" as they were termed, cut in it just over the wounds, so that they could be reached for dressing, failed to fill the bill, partly because the huge size of the windows necessary weakened the cast, and partly on account of the discharges or irrigating fluids working their way up and down the limb underneath it.

So we scrapped these altogether, and took over from the orthopedic surgeons a skeleton splint which had been found of great value in straightening the limbs and healing the diseased joints of little children. This was known as the Thomas splint, or, from the American modification of it, the Hodgin. This is

an extremely ingenious and at the same time simple skeleton splint, consisting roughly of a long iron rod about the size of a lead pencil, bent in the middle into the shape of a huge hairpin, about six inches longer than the limb.

The ends of the hairpin are socketed into a large rounded wooden or hollow metal ring about an inch and a half in diameter, wide enough to slip completely over the limb. This is slipped over the foot or head and pushed right up till it rests against the body — armpit or groin as the case may be — in such a position that the rods lie one on either side of the broken limb and the “bow” projects beyond the foot, stirrup fashion. Then a series of strips of bandage are carried across from one rod to the other underneath the limb and tied separately, so that the broken bone is supported on a sort of banded hammock, each band of which can be shortened or loosened as may be needed to make it rest comfortably.

A bandage is carefully applied to the ankle or wrist and the ends of that carried round the cross-bar or bow of the hairpin below the hand or foot, then the limb is gently pulled into good position, the bandage is tightened to hold it there, and the wounded limb, thus held in good position, is perfectly comfortable, and what is most important of all, with every inch of its wounded surface accessible at five seconds notice for dressing or treatment.

These skeleton splints are now kept on hand in every Advanced Dressing-Station, and even carried by the stretcher-bearers out into No Man's Land; so that the shattered limbs of the wounded may be "immobilized" and kept comparatively comfortable on their trip down to the Casualty Clearing-Station.

At the Casualty Clearing-Station, there are whole wards, and a little farther back whole hospitals, which are devoted exclusively to the treatment of fractures, particularly of the arms and legs. In these, great wooden suspension frames are built up over the beds like a sort of miniature traveling crane. These are most ingeniously equipped with little traveling carriages, pulleys and weights, rollers, and adjustable derricks, so that the injured limb is slung from them and skillfully supported in the precise position which is best for its healing and the patient's comfort. To keep the limb from shortening and the shattered fragments of bone from healing in bad position, which is one of the greatest problems of fracture treatment, a sort of stirrup is carefully fastened to the foot by means of overlapping strips of rubber plaster, or sometimes by a sort of laced or buttoned gaiter. From this stirrup a cord is run through a pulley on the framework at the foot of the bed, and a weight attached to the end of it, carefully adjusted so as to be just heavy enough to



A FRACTURE CASE IN A HOSPITAL ON THE WESTERN FRONT

keep the limb stretched at the proper length and in good position without fatiguing or over-stretching the muscles.

The shattered fragments of bone are drawn and manipulated into good position under ether with the aid of the X-ray, and then held there by the tension of springs or the pull of weights over adjustable pulleys. Then the damaged parts of the muscles are carefully cut away and the ends stitched skillfully together. The smaller damaged arteries are tied, and if the great main artery of the limb is torn or even cut across its walls, they can be brought together and stitched with fine catgut as neatly and closely as a tailor will mend a rent in a coat.

Even in such desperate conditions as the destruction of an inch or more of the great main artery, a carefully sterilized tube is slipped into the upper and lower ends and tied in to bridge the gap between them for a few days, until circulation can be established through some of the smaller side branches above and below the wound, when it is removed and the artery tied.

The net result of all this patient and laborious and painstaking skill is that out of ten arms or legs which would have been considered helplessly doomed to amputation twenty years ago, nine are now saved. A little weaker or stiffer, or an inch or so shorter, perhaps, but far superior to any wooden or leather or

steel and cork, or other artificial limb ever invented. These fracture frames set up over the beds are strong enough to support and sling up not merely an arm or a leg, but the whole body as well when necessary, as in wounds in the back and hips, and so perfect is the control of the position of the limb by their pulleys and cords, that even a badly shattered fracture of the thigh may be healed with a straight limb and little or no shortening, in some cases actually none at all. Furthermore, apart from this they would be worth all their cost and care just for the relief they give to the poor wounded, who after the weight and cradles have been properly adjusted, and they have got accustomed to the new position of the limb, can move about in bed and feed themselves and rest comfortably, and sleep as peacefully as children.

One devoted and enthusiastic young surgeon confided to me that in the beginning, when the appliance was new to him and he was most anxious to be on the safe side and to prevent any shortening, which is the rule in eight fractures out of ten, he had actually so thoroughly straightened and stretched a broken leg that it came out slightly longer than the sound one! But this was a minor and pardonable fault, as it only meant putting the extra half-inch heel on the boot of the sound side instead of on the broken one, and the patient would never know the difference.

The same enthusiasm gave beautiful results later, as he showed me in one ward nine men with severe fractures of the thigh who had been less than a week out of their slings, and who could walk the length of the ward and back without either a stick or a limp.

Nothing strikes one more forcibly in this war than the extraordinary toughness and powers of adjustment and resistance of the human machine. One scarcely knows at which to marvel most — the way in which men who have lived the sheltered, peaceful humdrum life of modern civilization all their days, never seen a shot fired and scarcely a blow struck in anger, within a few days or weeks come to take battle, murder, and sudden death as a matter of course and routine and face the most incredible of horrors and risks as part of the day's work, without turning a hair; or the way in which the most frightfully torn and shattered and mangled remnants of human stuff in the hospital, under the patient skill of the surgeon and the sleepless care of the nurse, will pull themselves together again into something resembling symmetry and the human form.

Luckily humans are not like Humpty Dumpty — they can be "put together again," without even calling in "all the King's horses and all the King's men." And the wonderful way in which the disabled and the crippled can be put together again, and made, not,

of course, as good as new, but skilled, efficient, self-supporting workers, is one of the medical triumphs of the war.

This calls for a new and special type of hospital, not merely a building with wards and beds and an operating-room and a staff of nurses and doctors, but an establishment roughly one third hospital, one third gymnasium and massage rooms, and one third manual-training school. So that directors of physical training, masseurs, and electro-therapeutists and teachers, particularly of manual-training schools and polytechnics, are as necessary and important members of the staff as surgeons and nurses. The nub of the problem and aim of the whole establishment is not so much how well and how symmetrical a man may be made to look again, but how good a living he can be trained to earn for himself.

This type of re-education hospital is particularly well managed and carried out in France. One famous one in Paris is installed in a great art gallery and exhibition building, the same where in happier times are displayed every year the pictures of the famed French Salon. Though the patients are not brought here usually until six months after they are wounded, and their wounds are nearly closed, yet so jagged and so horribly infected are the lacerations made by modern shell fragments that it often takes months and even years for them to heal completely and soundly.

This period is taken advantage of, for re-educating them for their life-work.

To everybody's delight it has been found that instead of delaying their recovery this actually hastens it distinctly and improves the final results. Indeed, the modern "joint" surgeon does not hesitate to say frankly that as much harm is as often done in the way of stiffening joints and paralyzing muscles by keeping wounded limbs too long in badly shaped splints or plaster casts, as by the original injury itself. Get the limbs out of their casts and splints and set their own muscles to work as quickly as possible, pulling them back into shape and usefulness, is their motto. Our methods of treating fractures of bones and injuries of joints have been simply revolutionized already by our experience in the war and will benefit thousands in future years after this terrible strife is ended.

By one of those curious reversals that war so often brings, the surgeons best fitted to treat these bearded warriors were those who had made a specialty of straightening the limbs and restoring the joints and bringing back the paralyzed muscles of little children, or orthopedists as they are termed. So that the healer of little children has become second only in importance in this war to the general or operating surgeon and great hospitals are being built for him and his students all over the warring countries. Thus our

cripples have to "become as little children" in order to enter the kingdom of healing.

One of the largest halls of the great Art Gallery in Paris was turned into a hospital ward where the men slept; beautifully light and airy, with gayly frescoed walls, but a little bit difficult to heat in winter-time, it was murmured. The smaller halls were occupied by a series of work-shops, some in which the patient himself was worked upon by all sorts of vibrators and batteries and electric currents and exercising machines of the Zander type, and the others in which the patient worked upon the machines and materials provided to learn his new trade.

While he was being massaged and shocked and pulled and pounded and exercised back into shape in the shops in which he was the raw material, the strength of the different groups of his muscles, and the amount of movement of which his joints and limbs were capable, were carefully tested out and measured. From the results were estimated first of all what his total strength was, whether he should be rated as quarter-man, half-man, or three-quarter man, so as to place him in the light, medium, or heavy-work class. Then the strength or deficiency of the different groups of his muscles was tested in order to find some particular occupation or task in which his strength could be used and his disabilities would not interfere. Then, after a preliminary try-

out to see whether he showed any aptitude for this particular job, or whether something else might fit his natural tendency or previous training better, he was set to work to learn his new trade.

There was nothing rigid or forced about the method, if the "mutilé" did n't make good progress and take kindly to his scientifically selected trade, he was tried out on another one. In fact, the men were not infrequently given training in two or more trades which could be carried on together in villages and little country towns — such as cobbling and tool-sharpening, for instance — where there might not be enough demand for either alone to make a good living.

In all there were some nineteen or twenty different trades taught, ranging from carpentry, cobbling, metal-work, and harness-making to photography, book-binding, and printing.

The Director, who was a doctor and physical director of a large college gymnasium, was an enthusiast and inspired his patients with the same spirit. It was a pleasure to see the enthusiasm and energy with which they went about the work of overcoming their defects. Thanks partly to the universal use of machinery in modern industry, so that great muscular strength is no longer necessary, partly to his devoted skill in fitting the disabled man to the particular task which suited him, the doctor assured

me that, somewhat to his own surprise even, he was able to make more than two thirds of his patients "full hands" at some particular trade.

Then he brought his infectious enthusiasm to bear upon the employers and brought them to see that so long as a man did full work they must pay him full wages, regardless of how much of him might be missing: with the gratifying practical result that not one of his graduates was earning less than eight francs a day, which was very good wages at French rates, the equivalent of nearly four dollars a day, American standard; men after training earned more.

As something like two thirds of the population of France is peasant, special attention was given to "little" trades, like cobbling, harness-making, tool-grinding, tailoring, etc., such as could be carried on in small villages. And in addition there was a special branch affiliated with the hospital, a farm school out in the country, where the cripples who wished to go back to the soil could receive special training in modern methods of farming, particularly gardening, dairying, and what the French call "la petite culture"; that is, poultry, rabbits, bees, etc. This school is situated on a beautiful old French farm, about ten miles from Paris, close to a large military hospital, where the pupils live and receive such medical care as they need during their course.

Happily the number of these hospital schools re-

quired will be smaller in proportion than in any previous war, on account of the splendidly successful way in which the Hospitals at the Front have done their work. So far it is estimated that the cripples and severely disabled men are about one tenth of the men killed, — that is to say, from two to five per cent of the wounded, — but there will be enough at the best, Heaven help us!

After visiting France one is frequently asked whether the eye is not perpetually saddened everywhere, on the streets and in the trains by the sight of pitiable cripples — armless, legless, blinded, and otherwise terribly mutilated victims of the war? The answer is, not to anything like the extent which one would have expected, partly because the surgery has been so skillful and successful, partly because the crippled soldiers, instead of being sent home or turned out to shift for themselves, are splendidly taken care of in these great re-educational establishments until they can be fitted to a new niche in life. Finally, because, when their re-education is completed, their shattered joints limbered up, their new arms and legs carefully fitted in the best modern style, they are able to go about their work so briskly and confidently that in their street clothing the average eye would hardly recognize them as cripples.

XIV

THE NEW DISEASES OF THE WAR

THIS war, though it has introduced many new and unexpected situations, has added little that could be really termed original, not even in the realm of disease. Only three diseases have appeared in four years of it which could really be termed new, and these all bear the name of its most striking feature, Trench Fever, Trench Nephritis, and Trench Feet. These are comparatively mild diseases, not to be compared in either dangerousness or frequency with typhoid, diarrhœa, or dysentery in the old days, and seldom prove fatal. But they are severe enough to disable a soldier and common enough to be annoying, and what makes them particularly exasperating is that after years of laboratory research we are still in the dark as to the cause of the last two and only partially enlightened as to the first.

Trench fever is a curious relapsing fever something like a mild form of malaria. The patient comes down with a sharp rise of temperature, and pains in his back and limbs, then after four or five days of fever he improves and seems to be getting better, and suddenly, without any apparent cause, up goes his temperature again, and so the process repeats itself for four

or five weeks. He is never very seriously ill and usually recovers completely when he is sent back to the Base or to England, but he is "off the strength" for a considerable time and is rather apt to break down again with another attack after he comes back to duty.

Though a number of organisms have been accused and "shadowed," the criminal one has not yet been discovered, but there has been a growing consensus of opinion that the disease is due to an infection carried by the bite of the louse, supported by the fact that the disease is becoming distinctly less common as the trenches are better drained and sanitated, and the men well supplied with hot shower baths and clean underwear.

Indeed, within the last few months, the problem has been definitely and successfully attacked by the ever-victorious method of direct experimentation upon human volunteers. Groups of soldiers, chiefly from the Medical and Sanitary Corps, volunteered for this splendid service to humanity, first in the English and Canadian and then in our American army hospitals, with the result of conclusively proving that trench fever, like typhus, was transmitted by the bite of the body louse, now enjoying a wide notoriety, if not favorable reputation, under the name of "cootie."

Insects which have been living upon men known

to be infected with trench fever were transferred to the bodies of healthy men, but the first results were somewhat puzzling, inasmuch as while infection did sometimes take place, this was only in a small proportion of cases, and in some groups the result of lice transference was almost entirely negative.

What made this the more puzzling was, that the disease could be surely and promptly transmitted by inoculating healthy men with the blood of those suffering from it. There must be some third factor at work, and this turned out to be a rather unexpected, and to say the least of it, a rather distinctly unæsthetic and undignified one. It suddenly occurred to one of the younger doctors that the men who were voluntarily undergoing this experiment were bearing the discomfort of their infestation in the most Spartan fashion, and were scarcely scratching themselves at all. On inquiry he quickly found that having submitted themselves for this serious and most important experiment, they considered that it was beneath their dignity to scratch, and also that it might perhaps interfere with the success of the experiment and the accuracy of the result.

A suspicion dawned in the young man's mind that perhaps their stern and stoic self-restraint might have produced just the opposite effect from what was intended, and he thereupon gave them free leave and license to excoriate their itching surfaces as heartily

as they wished. The result was that every one of the squad developed a beautiful case of the disease within four or five days.

The secret of the disease was discovered. The pestilent insect unquestionably infected itself through the blood which it drew from the patient, but apparently only occasionally secreted the germ through the glands of its mouth parts, as the mosquito, for instance, does the malaria germ, so that it was only occasionally that its new host would be infected by its bite. But if the whole body of the louse was crushed upon the surface of the skin and then rubbed into the tiny abrasions produced by scratching, the germs in its body would be certainly absorbed into the new patient's blood. It also appeared that the excreta of the lice contained the germs of the disease, and that these, when deposited upon the skin and scratched in, would infect the new host.

Again, as often happens, duty and pleasure do not run hand in hand, and the best cure for the itch is not, as the old pessimistic proverb used to have it, "to scratch," to say nothing of avoiding trench fever.

So that by the free use of the hot shower bath for the bodies of the men and the steam sterilizer for their clothing, in the now famous and unspeakably beneficial "delousing" or "unlousing" establishments described in the chapter "Mountains and Medicine," not only will this distressing disease be stamped

out, but the Army will be relieved from one of the most annoying and exasperating of its discomforts. Great progress has already been made in this latter direction already, and it would be safe to say that infestation with "cooties" has become the exception instead of the rule in our armies. And with this added incentive to push to its utmost limit the fight against these wretched little pests, of stamping out trench fever, which was estimated at one time to keep nearly five per cent of the Army in the field more or less constantly on the sick list, the plague will ere long be stamped out altogether.

Trench nephritis, as its name implies, is a slow inflammation of the kidneys with albumen in the urine, a sort of mild and curable form of Bright's Disease. Like trench fever it runs a slow and irregular course and usually ends in recovery — indeed, the few cases which do not are mainly those in which there is reason to believe that some chronic disease of the kidney had existed before the attack.

Various causes are suggested for trench nephritis — the terrific exposures to wet and cold and mud in the trenches, germs from the trench mud, sudden strains as of emergency marches under heavy packs falling upon men of indoor occupations and trades, irregularities of diet, etc. — but none of them have been definitely proven. The weight of opinion is rather in favor of the view that all these play their

part and that the disease is not due to a germ, which is rather supported by the fact that it is most common in winter, and that a battle or extensive changing of lines, with long, exhausting marches, is often followed by a fresh crop of cases.

It is significant that in these alternations of violent activity with comparative stagnation, the natural food relations are reversed, the rations being somewhat scantier, drier, and less attractive on route marches and in the front-line trenches, and very abundant and attractive in the rest-camps and underground galleries in support behind the third-line trenches.

At all events, strong and successful efforts are being made to equalize and balance up between the alternations, both of extremes of activity and of food, so far as the stern necessities of war will permit; sending up at great risk to life regular supplies of hot food to the front-line trenches and cutting down upon wastefully abundant rations in the rest-camps, while pack drills and practice marches are kept more within the limits of endurance of the less sturdy men, and the amount of active exercise and even light labor in the rest-camps increased — considerably more, in fact, of the latter than Mr. Thomas Atkins or Jacques Poilu appreciates with any cordiality. And the disease, whether in consequence or as a coincidence, is distinctly diminishing in both severity

and frequency as these and other health conditions are more carefully studied and adjusted.

When the full misery and hardship of trench warfare in snow and sleet and bottomless mud began to dawn upon us in the gloomy winter of 1914, one of the torments that stood out first and most prominently was a painful and peculiar inflammation of the feet, ankles, and legs, dubbed by the soldiers "trench feet." It looked and behaved like a cross between chilblains and frozen feet. The feet would first swell and turn dull red and purplish; then the skin would begin to itch and burn intolerably; then, if bathing and antiseptics did not check the process, little blisters and pustules would rise up all over the surface, the purple color would deepen to bluish black, and a superficial gangrene of the top of the foot and toes and occasionally the soles would begin to set in. So severe was the gangrene that large patches of the skin and surface of the feet would die and slough away completely, while in the worst forms it would look as if an amputation would have to be done in order to prevent the absorption of the poisons of decay into the system.

It was an extremely obstinate, painful disease, and while as a rule it could be checked with little worse than the sloughing and ulcerating away of a few patches of skin, it threatened to become serious from a military point of view, for it was almost totally

disabling while it lasted, and at one time was so common that it was estimated that nearly ten per cent of the soldiers in Flanders and Northern France, on both sides of the fighting line, were constantly laid up by it. In fact, it became so troublesome that a special commission was appointed to inquire into its causation and see what could be done to prevent it.

Because the disease first began in winter, when the men were complaining bitterly of the cold and also because it started like an attack of chilblains and ended like a bad case of frost-bite, it was supposed that extreme cold combined with wet was an important factor in causing it. But it was quickly found that although the cold undoubtedly aggravated and hastened the process, as a matter of fact the mud and the water in the trenches were almost never frozen, so that the men's feet were seldom exposed to a temperature below freezing: certainly not enough to produce genuine frost-bite, or anything approaching it.

Moreover, the disease showed no special tendency to diminish with the coming of the warmer weather in the spring, except where special measures had been taken against it. I was much interested to discover, on my visit to the Italian Front, that during the first year of their trench warfare, their soldiers had suffered very severely and extensively from trench feet, although such a thing as a frost is rare along the Isonzo. In fact, Gorizia, Gradisca, and Monfalcone are all

celebrated as winter health resorts. But they had plenty of the two real causes of the disease: undrained trenches and infected mud.

The first thing discovered that pointed in the direction of relief was that pressure of both boots and leggings had a good deal to do with the production of the disease. The army boots were fairly comfortable and loose-fitting, but the soldiers, knowing that they would often be standing up to their ankles or to their knees or even waists in thin mud or water, naturally were inclined to lace up their boots as tightly as possible, so as to keep them from leaking from above. This seriously interfered with the return circulation of the blood in the feet and started them to swelling, which, of course, raised the pressure still higher and set up a regular "vicious circle."

Boots at least two sizes too big for ordinary wear or marching purposes were issued to the men, and they were instructed to wear heavy woolen socks and to avoid lacing their boot-tops too tightly. But the more serious binding was found to be due to the puttees and leggings worn by the men, and of the two, most unexpectedly, the puttees were the worst.

This was due to the fact that in order to hold in place and present a trim and soldierly appearance, it was necessary to wind these curious woolen leg-bandages so tightly that the big surface veins of the

legs were severely pressed upon, making the feet first swollen and then cold.

New methods of winding them round the legs were devised, after the fashion of what is known as a "spica" bandage in surgery, which would enable them to cling to the leg and yet not grip it too closely, and by means of this, with the looser shoes and double socks, the amount and severity of the disease were considerably reduced.

Still it continued troublesome, until the idea finally took shape that the real, underlying cause of the plague was neither wet nor cold nor tight foot-wear, but slow infection of the skin from constant soaking in the foul, infected mud of the trenches.

This was attacked in two ways: By installing a regular system of motor-driven pumps to empty out the low spots, or specially constructed drainage pits and basins in the saps of the trenches. Another way was the extension of a complete system of the blessed duck-walks or wooden grating sidewalks which are elsewhere described.

But the finishing touch in the conquest of the plague was put, I am happy to say, by another American invention, and that was the good, old-fashioned hip rubber boots of our happy boyhood days in the duck-swamps and the trout-streams. Duck-boards and duck-boots together were the winning combination.

I found along the English Front in Flanders, at the Battalion Headquarters of each section of low-lying trench, hundreds of pairs of high rubber boots which were issued to the men as they went on duty for their three days' turn in the front trenches. With real English thoroughness there was also a special drying-chamber, to which the boots were promptly taken as the men turned them in on their return from duty, where they were dried and warmed on special racks, so as to be in good condition for issuance to the ingoing squad next day. These, with plenty of thick woolen socks inside, are an almost perfect preventive and protection against trench feet.

One other element, however, was found to be quite important, although it sounds at first sight rather trivial, and that was thorough and scrupulous cleanliness of the men's feet and frequent changing of their socks.

One cheerful young subaltern, whom I met on a train, who did not know I was a doctor, was good-naturedly grumbling at the dreadful amount of what he called "nursemaid work" which an officer was nowadays required to do for his men. "Why, you know," he said, "these doctor johnnies have got such a lot of fussy regulations passed that I actually have to see, not only that my lot get clean underwear and clean socks twice a week, but that they put 'em on, and if they have n't got 'em on when inspection

comes, I get a wiggling. I've got to go round every night and see that they have greased their little feet and washed their pretty pink toeses before they go to bed. But I'm bound to say that the beggars keep as fit as fighting cocks with it all."

Greasing the feet and legs with whale-oil or other thick tenacious grease and keeping the men moving and stamping about in the trenches, so as to keep up good circulation in their feet, were found also helpful.

The same method applied to the trench feet in the Italian Army produced an almost complete clean-up of the condition.

Now that trench warfare has been reduced to a science, new intrenchments are dug and planned with special reference to drainage as well as to defense. Rain and earth mixed together make mud, but they have to be churned and kneaded into each other to develop any considerable degree of either depth or gumminess. If anything like a reasonable slope for the drainage of rain and storm water is provided, even the clayeyest and stickiest of soils will "shed" two thirds to three fourths of the water that falls on it before it has time to be kneaded into paste. So that with scrupulous cleanliness, loose, warm foot and leg wear, and reasonably drained and grated trenches, the soldier who now enters the line of battle need have little fear of trouble from trench feet.

The disease has diminished in a most rapid and gratifying manner and such cases of it as now occur come chiefly after a long offensive like those of last autumn when men have gone forward from the trenches altogether and been obliged to hold positions consisting simply of shell-holes half-full of mud and water for days at a stretch. When visiting the Front in Flanders in April last year I had hard work to find a well-marked typical case of trench feet, but on returning in October, after the capture of the ridges, I saw quite a considerable sprinkling of cases from shell-hole conditions of this sort, but they were fortunately of rather a mild type and all rapidly recovering.

One decidedly interesting and consoling fact strikes one very forcibly all along the battle-line, and that is that in spite of the most terrific and constant exposures to cold and wet and mud, in the most abominable of weathers there has been extraordinarily little rheumatism, or gout, or neuritis of any sort. This is the more striking because the troops have in addition been exposed in a very high degree to the other supposed cause of rheumatism, red meat and uric acid in all its forms. The men have had practically all the meat that they could eat and all the tea or coffee they could drink twice and sometimes three times a day — not merely for months, but for years, and yet gout, rheumatism, and arterio-sclerosis are

conspicuous by their absence. A more complete and overwhelming explosion of the vegetarian delusion and the uric acid myth could hardly have been imagined.

XV

KEEPING THE CAMPS HEALTHY

NEXT after putting a roof of some sort over the soldier man, and walls round him to enclose a small slice of the universe, cut out of the wide, wide world, which could be heated and dried at pleasure, comes the question of keeping him dry under foot. Or, in other words, keeping him up out of the mud.

The capacity of the solid surface of *terra firma*, under the perpetual paddle of feet or the grind of heels, for turning into a semi-liquid and churning itself into a sticky sea of bottomless mud is simply limitless and incredible — until seen or felt.

The driest and firmest and most porous patch of the brown surface of Mother Earth only needs a little puddling during a steady rain to turn into a gummy, rubbery sponge which holds water as bread dough does gas, and which possesses a fiendish power of apparently eating its own way down into the depths.

So, when a regiment sits down upon a particular plot of acres, and proceeds to make itself at home, the runways over which it passes backward and forward upon its lawful occasions rapidly turn themselves into winding troughs of sticky glue, until the camp seems to be in danger of literally miring down.

•

This is no mere figure of speech so far as man's faithful partner in warfare, the horse, is concerned. I talked with one French artillery officer, who was heartbroken over the sufferings of his poor horses. He said that during the winter it had been necessary, for military reasons, to keep them picketed or "stabled" in an open field, with no roof over them. The ground was fairly porous and well drained to start with. The horses were well fed and carefully blanketed so as to protect them as much as possible. But there was a steady succession of light, pelting rains, and under their constant stamping and shuffling, the ground beneath them steadily and relentlessly churned itself into a bog of mud, first fetlock deep, then knee-deep, until they literally seemed to sink into the earth, and the hostlers would have to go round in the morning and pull some of the horses, which had been rash enough to attempt to lie down, out of the bog in which they were embedded.

It was impossible to move the horse-lines, because this was the only patch of ground of sufficient size, within reach of the battery, which was protected from the enemy's fire. And my lieutenant, who evidently loved his horses as if they were his own children, said he never felt more relieved in his life than when at last the battery received orders to move and he could get his pets once more under a roof and with warm, dry bedding underneath them.

In the earlier days of the war, the condition of the men in the trenches was not so very distantly removed from that of the unfortunate artillery horses. They were literally up to their knees and often up to their hips in mud, not only in the trenches, but on the paths and roads they had to flounder along back to the camps and huts, and even between the huts themselves.

But all this has long been changed for the better and largely got rid of; partly by greater skill and care in the surface drainage of the camps, partly by laying down solid paths, like little roads, with broken stone and ashes, and even empty tin cans, smashed flat, but chiefly by one very simple, but magnificently useful and effective, device, known as the "duck-walk" or "duck-board."

These "duck-walks," to the honor of the New World be it said, are an American institution, introduced by the Canadian troops, and are nothing more nor less than the primitive grating or battened sidewalks of the lumber-camps in the Big Woods, made of two pieces of two-by-four scantling, about sixteen inches apart, with battens of rough one-inch strips nailed across them, an inch or two apart. They are usually made in about eight-foot lengths, so that the sections can readily be picked up and carried to be laid wherever needed; and for all their simplicity, they are regular life-savers. The mud was

not only extremely disagreeable and destructive to clothing, to say nothing of reducing the speed of all operations over the surface from fifty to seventy-five per cent, but it was extremely unhealthy. It worked its way through the boots and puttees and clothing of the men, and caused distressing irritations and inflammations of the skin; one form of which culminated in the dreaded "trench feet" or "trench gangrene."

This was little to be wondered at, because sanitary arrangements are very difficult to carry out thoroughly and scrupulously under almost incessant shell-fire. The mud could hardly be described as clean mud, as there were from five thousand to seven thousand men to each mile of trench, and in the earlier days of the war, when no one had any idea of its ghastly permanence, the dead had been buried pretty much where they fell, in some instances, under heavy fire, in niches scooped out in the walls of the trenches themselves.

Not only did serious results come from the wet mud, but quantities of it, of course, dried on and stuck to the clothing or was tracked into the huts, where it turned to dust which both irritated the noses and throats of the men and greatly favored the breeding of fleas and other even more intimate parasites.

Altogether, the soldier's grumbling about the mud,

which he regarded as a far more annoying enemy than the Kaiser and worse hardship than shell-fire, had abundant justification; it is literally a plague and pest, and the good influence which has been most powerful in exorcising it has been the blessed "duck-walk." It can be laid almost overnight; it will not sink into the ground, even in the boggiest spots, but half-floats, half-spraddles itself above the bog; it can be laid upon supports, thrown across the bottoms of the trenches and raised or lowered according to the ebb and flow of the slimy tide of mud.

Crushed stone is excellent, if you have plenty of it, but short lengths of it will be literally buried under the tons of mud deposited on it by hundreds of hurrying feet, and no rain will wash it clean, while the "duck-board," by virtue of its porousness and lightness, is almost self-cleaning and comes up fresh and smiling after a shower.

I was talking with a group of prominent officers of the Army Medical Corps — colonels of the Sanitary Staff — and the question happened to come up: which had been the greatest medical invention of the war? One said the anti-typhoid vaccine, another the Carrel treatment, the third, the "duck-boards"; and he pretty nearly succeeded in convincing the other two that he was right.

I had equally convincing testimony from another point of view, in conversation with a prominent



A STRETCHER-BEARER PARTY COMING THROUGH THE MUD



A BRITISH TOMMY HELPING A GERMAN PRISONER CARRY A
WOUNDED GERMAN THROUGH THE TRENCHES

Army Engineer on the Western Front. After talking about the great variety and huge amounts of material required by a modern army, he asked me: "Now, what do you suppose, Doctor, is the most pressing need of the Army at present?" I guessed steel rails. "No," he said, "it is n't; it's crushed stone for the paths about the camps and the roads leading up to the trenches."

Swift, safe, certain movement, in all weathers, whether of men, munitions, or food, or wounded, is the very life-blood of an army.

The name "duck-board" seems to have been given to them in affectionate derision by the English troops because they resemble the little ladders or slatted boards laid for poultry to walk up to their houses or roosting-places, perhaps also in allusion to their web-footed and unsinkable qualities. The French troops, who have also adopted them, have an equally farmyard name for them, "caillebottis," which means curd-racks—the slatted racks on which curds draining for cheese are placed in the dairies.

Germs have their victories no less renowned in war than in peace. The soldier's worst enemy enlists with him, and the deadliest foe and the thing that kills most men in war is not bullets, but bugs and bacilli. Whenever you mobilize and call to the colors a thousand men, you call with them at least twenty

billion tubercle bacilli, ten billion typhoid, five billion pneumonia, and a couple of million each of the germs of measles, cerebro-spinal meningitis, diphtheria, and rheumatism.

In other words, there will be twenty cases of half-healed, chronic or latent consumption, ten who have recovered from typhoid but are still "carriers" of the bacilli, five at least whose noses and throats are still swarming with pneumonia germs, and two each who still carry about with them odd, surviving colonies of the germs of measles, diphtheria, meningitis, and even mumps.

The younger the soldiers the more certain you are of a full crop of these left-over germs, these "remnant" bugs which are eager to start a "bargain sale" spread whenever they are provided with plenty of fresh customers.

An army assembles literally primed and loaded for trouble from the inside, ready to break out with epidemics, months before it ever comes within gunshot of the enemy. And it invariably does break out unless the Sanitarian is sleeplessly on the job day and night.

Five times as many soldiers, for instance, in our Spanish-American War, died of typhoid carried by flies from open latrines containing the feces of infected "typhoid-carriers" to unscreened food, as fell by Spanish bullets. Nearly twice as many Eng-

lish soldiers died of the same disease, spread in the same manner, in the Boer War, as fell in battle.

Just why and how there should occur this extraordinary explosion and expansion of disease among groups of healthy young men in the very prime of life, and from germs which they themselves are carrying about with them quite "unbeknownst" to themselves, is something of a puzzle. We have, of course, a familiar parallel in the fierce epidemics of the same diseases which so often break out in boarding-schools, orphan asylums, convents, etc. It would almost seem as if a given strain of germs was able to adjust itself to a particular age of victim, and whenever, out of the thousands of lurking "carrier" germs in a large "one-age" group, one strain happened to be adjusted to that particular age, or became so after several trials, it would then run like wild-fire through the entire group, school, regiment, or mining-camp as the case may be; for our Western mining-camps have also furious epidemics of pneumonia and meningitis of this sort.

In fact a curious apparent parallel exists in the plant world, as forestry experts have long found by bitter experience, that it is utterly unsafe to plant new areas in "solid" masses of one particular species of tree, because if a bacterial blight, canker, or other infectious disease gets a start anywhere in the young forest and gets "tuned" to the key of the species, it

will run through every last acre of it like a prairie fire. If, however, the young trees are planted in alternating bands or zones of different species, and the more widely different the better, then a disease starting in any one of these is checked by the "strange" belt on either hand and can gather so little headway that it can easily be brought under control and stamped out.

Whether this is the explanation or not, the annoying fact remains that measles, mumps, diphtheria, and meningitis are the bane of the training-camps whether in France, in England, or at home in our cantonments; so much so that experienced commanders distinctly prefer city and town bred recruits to country bred ones because they are far more likely to have had most of these minor pests in childhood. Indeed, the difference was strikingly illustrated in this war, for of all the various British troops it was the Australians, the New Zealanders, and the Canadians who suffered most severely from such "second childhood" attacks. The men were superb physical specimens, none finer in the whole Allied armies, but they simply had been born mostly in small villages or towns and isolated bush settlements out in the open country and so escaped exposure to one or more of these plagues of childhood. In support of which theory it was the Newfoundland regiments which suffered most severely of all, while in the Eng-

lish home armies it was the lads from the Orkney Islands and the Hebrides archipelago who held the same unlucky distinction.

Incidentally this is no argument whatever for having these diseases in childhood and "getting them over" while you're young. On the contrary, all these Colonies have among the lowest infant mortalities and childhood death-rates in the world, New Zealand the very lowest, 33 per 1000 births as against America's 110 and England's 120, while there is good reason to ascribe part of the superb physique and high average stature of these young recruits to their escape from the prostrating and chronic poisoning after-effects of these serious and much underestimated "little" diseases of childhood.

The total net disadvantage of such escape is simply a little temporary annoyance to a few Army doctors and drill sergeants, and we can't inoculate the whole world just to suit their convenience; especially as we hope it will never be necessary again, at least in our lifetime, and won't be when we get all the Boche Beast's teeth drawn.

The actual effects of these belated children's diseases in training-camps, although very annoying, are usually comparatively slight and temporary, with the exception of meningitis and diphtheria.

But they seriously interfere with training, occasionally assume very severe and even fatal forms, and

if allowed to spread unchecked would unquestionably result in the disabling for months, and even years, of a considerable number of fine young soldiers. Even when promptly recovered from, they often leave the bronchial tubes, heart, and kidneys in a weakened, irritable condition for months afterwards, or are followed by secondary pneumonias of great severity, as painfully illustrated in our cantonments last winter and during the influenza plague this fall.

The only protection against them is ceaseless watchfulness on the part of the regimental surgeons, to detect and isolate the very first cases at the earliest possible moment. One of the first sanitary requirements of a camp nowadays is an isolation ward or small hospital for all cases showing any signs or even suspicious symptoms of any sort of infection, including "common colds": "tonsillitis wards" as they are called.

If diphtheria appears, in addition to isolation of patients, preventive doses of anti-toxin are given to all whom they have come in contact with, and everybody's throat is examined and "swabbed" for bacteriological examination to detect "carriers" of the germs. Then they, too, are isolated till their throats are cleaned up by sprays and anti-toxin. It is not necessary to give anti-toxin to those who give a clear history of a previous attack or who react to a skin test or "vaccination" known as the Schick test.

Measles, though less directly serious, is very difficult to check, because its most infectious stage is before the patient shows any signs of disease or even feels sick. Indeed, the recently claimed germ of the disease has disappeared entirely from the patient's body before the rash breaks out.

Fortunately, however, one of our American Army sanitarians has discovered that the germ is quickly killed by direct sunlight, and if all the bedding, clothing, and entire kit of the recruits are spread out in the hot sun every day for two or three days in succession, the further spread of the disease is usually promptly checked.

The most serious alarm of all was caused by the series of small epidemics of cerebro-spinal meningitis ("spotted fever") which occurred among the Canadian and other Colonial troops in their training-camps in England early in the war and as soon as we came into the war in our cantonments at home. In this case it was doubtful whether the infection was brought by the troops, or whether it was caught from the surrounding civilian population, with the balance of evidence in favor of the latter source.

The disease proved extremely obstinate and difficult to stamp out, and though by the vigilance of the Army sanitarians the total cases were kept down to a few hundreds and the deaths to a few score, yet it was a hard, troublesome long-drawn-out fight to

clean it up altogether, and the end was only reached a few months ago. The most effective means of preventing it was found to be antiseptic sprays of thymol or dichloramin in the noses and throats of all "suspects," "carriers," and "contacts"; that is, all who had carried the germs of, or had come in contact with, the disease: for epidemic meningitis enters the system through the nose and is spread by sneezing and coughing.

Of course, from the deadliest plague and heaviest curse of army camps, typhoid, our troops have been completely and triumphantly delivered in this war by the anti-typhoid vaccine.

XVI

THE PROBLEM OF TUBERCULOSIS

AT first sight scarcely any two things could be more strikingly different and diametrically opposed to each other than war and consumption. As a mode of death the one is swift, vivid, dramatic; the other, slow, feeble, colorless. It was the proud ambition of all the old fighting men of song and story to die in battle, "with their boots on," and their greatest dread and horror was "a straw death," a feather-bed end, after a lingering decline.

The warrior and the consumptive are just about at the opposite poles of human possibilities. Yet up to thirty years ago the warrior who enlisted for a long war had about twice the chance of dying of consumption that he had of falling on the field of battle, and to this day the commonest cause of death among armies in barracks is tuberculosis.

The reason for this rather surprising and half-incredible state of affairs is a fairly simple one. It is along the line of the old Latin saw about *Cælum non animum mutant*; we can change our climate, but not our disposition, or, in modern terms, our outside habits, but not our inside bugs.

Ninety per cent of us are "loaded" with the tuber-

cle bacillus from our childhood days — one or more slumbering colonies of him tucked away in some part of our internal anatomy. Whenever we become sufficiently depressed, and out of sorts from any cause, to soften and weaken the wall that imprisons him, out he comes ready for war.

Whenever the food-supply of the soldier becomes bad or scanty, when his water becomes foul or his sleeping-places verminous, when he is crowded and packed into winter quarters in caves dug in the hill-sides or in shacks covered with earth, when he has wasted away from the hectic fever and heavy sup-puration of festering wounds, then the tubercle bacillus claims him as its own and carries him off, just as it would a half-starved sweat-shop worker in an attic or an overworked slavey in a cellar kitchen.

In the sixteenth and seventeenth centuries galloping consumption and tuberculous pneumonia were high among the plagues which melted away troops in their winter encampments faster than the onslaughts of the enemy could in the field.

So, when this war broke out and began to assume its underground character, with the troops half-buried in the trenches all day and completely so in dug-outs and cellars and underground shelters at night, sanitary experts were quite prepared to expect a serious and widespread outbreak of tuberculosis in their ranks. But for the first two years of the war

they were most agreeably disappointed; instead of the troops in the field showing more tuberculosis than in previous open or aboveground wars or in civil life, they actually showed far less. Indeed, the general health of the soldiers in the field was better and their disease and death-rate less than the average of soldiers in barracks before the war. With certain exceptions which will be discussed later, our success against tuberculosis has been almost as complete in this war as it has against typhoid, typhus, diarrhoea, dysentery, and cholera.

This gratifying result seems to have depended largely upon two things — food, and protection from other, even slight infections. The tubercle bacillus, like the poor, we have always with us, and whenever he can he will do us ill, but the two things that give him the best and most favorable openings are starvation and other infections, notably typhoid, measles, and common colds. From both of these wicked partners the superb food-supply of our armies in the field, and the relentless and successful fight waged by the Sanitary Corps against all infections of every sort, big and little, have protected our armies in Flanders more perfectly, probably, than any like body of men was ever protected before.

The one unfavorable influence — the half-underground character of the fighting and the poorly ventilated and lighted sleeping-places that the soldier

has been compelled to occupy both in the fighting line and reserve — appears to have been completely neutralized, partly by the rich and abundant food, and partly by the merciful fact that when strong, vigorous men in the prime of life spend the greater part of their working hours in active exercise in the open air, they seem to be able to consume their own smoke at night and sleep in almost any kind of a cave or kennel, for some time, at least, without obvious damage. As, for instance, Banks fishermen, who literally choke the lamp out by exhausting the oxygen on stormy nights in their air-tight fo'castle, and farmers whose bedroom windows are hermetically sealed all winter.

Not only has there been no new development of tuberculosis in healthy soldiers under the strains and hardships of war, but many even known to be tuberculous before enlistment or conscription have gained weight, improved in health, and made active and useful soldiers.

Burnand declares that many tuberculous patients actually escaped from French sanatoria and enlisted, and that the majority of them kept up well and rendered excellent service.

Faginoli reports that many Italian and Austrian consumptives in the incipient stage went to the Front and were greatly improved by active service.

Banks traced forty-eight known cases, most of

them former sanatorium cases, who were accepted by the English Draft Boards, and nineteen of them were sent into active service, and out of the whole number only one broke down!

In Osler's opinion the number of latent tuberculous who broke down in military service was less than might have been expected if they had remained in civil life.

Fishberg, after a careful and thorough study of the literature of all the warring countries, concludes that the morbidity and mortality from tuberculosis among the belligerent nations has not increased during the war.

Renon in France declares that there was no increase of tuberculosis either in the Army or among the civil population during the first three years of the war.

And all authorities are agreed that such tuberculosis as does occur among the soldiers is invariably the reactivation of an old focus, the awakening of a dormant infection, which existed long before the war, as clearly shown by the histories.

General Tuffier told me personally that he had known numbers of men with old healed or dormant tuberculosis who had entered the Army and gained weight and strength, as if they had taken an open-air course.

The one element of the diet which has probably

contributed most to this splendid showing against the tuberculosis devil and all his works has been the abundance of meat. Everywhere one goes along all the Fronts, one is struck by the fact that meat in some form appears upon the mess-tables and in the ration-tins at almost every meal, bacon or ham or hash for breakfast, roast meat for dinner, and cold meat, ragouts, goulashes, and other meat stews with vegetables for supper.

On the clay flats of Flanders, on the rolling hills of the Somme, on the green mountains of Alsace, and along the Alpine ridges of the Italian front, when the rationing parties began to distribute their burden to the men in the trenches, I found the leading dish always a generous can of hot, savory, comforting meat stew, for each Tommy, Poilu, Yank, or Alpini. And the men simply thrive on it.

Never has there been a more convincing refutation, upon a larger scale, of the silly old superstition that meat is merely a luxury, that we should be healthier without it, and that its extensive use is followed by all sorts of maladies and mischiefs. Seven million men on the Western Fronts have now for more than two years had almost all the meat they could eat, at least twice and often three times a day, and the special diseases and disasters which were supposed to be caused or aggravated by meat-eating — gout, rheumatism, arterio-sclerosis, Bright's disease, liver

trouble, and paralysis — have been strikingly conspicuous by their absence.

The only exceptions which could even be claimed by the “meatophobes” are a curious type of mild inflammation of the kidneys, known as trench nephritis, which is now practically proved to be due to other causes, and an increase noted by some Army surgeons of irritability of the skin and a tendency to dermatitis. But the skin irritability has a way of almost entirely disappearing under the simple remedy of two hot shower baths a week instead of one.

Everywhere you go along the lines the armies are simply radiant with health and vigor, with spirits to match, and if a liberal meat diet could produce one fifth of the evil consequences which many of our dietitians, both lay and medical, so confidently ascribe to it, they would surely have begun to show themselves somewhere, in some measure, before this time.

In an army, as in a nation, vigor, both physical and mental, and progressiveness run in proportion to the amount of meat consumed per capita up to ninety pounds per annum. The only reason under Heaven why any nation, or class in a nation, does not eat abundance of meat, at least twice a day, is that it can't get it, either on account of poverty or lack of intelligence. The healthiest and most vigorous rice-eating or potato-eating or cassava- or banana-eating

nation in the world can be "fed up" to thirty to fifty per cent higher working power and healthfulness by a liberal addition of meat to their diet.

What is more to the point in the present instance, the widespread colonial experience of both England and France with native troops has shown overwhelmingly that almost any tribe or race of black, brown, red, or yellow varieties of the *genus humanum* can be made into first-class fighting men by feeding upon even an approach to European army rations, containing meat, fat, and wheat bread.

The next important anti-consumption element in the Army ration has been the liberal supply of good bread. Not only has the Army bread-ration been liberal to the point of extravagance, but the quality of the bread is much better than that supplied to the civil population. This I found to be the case on practically every Front that I visited, and other observers with whom I have talked give the same experience. Indeed, outspoken and unhesitating testimony to this effect is volunteered by almost every Tommy who comes home on leave, or *poilu* on "permission." This is due, in part, to the fact that the Army bakers and cooks, under the watchful supervision of the Medical, Sanitary, and Army Service officers, do their bread-making more intelligently and carefully. But most of it is due to a lower percentage of bran and other indigestible husks in the flour.

A considerable amount of the Army flour has been bought by contract abroad, and hence is of the civilized or white variety. And this, when mixed with the eighty-five per cent war-bread flour, has mitigated its indigestibility. In several places I found that the Army bakers, having their bread-ration issued to them in the shape of flour, were deliberately sifting or bolting it before making it into bread, so as to remove a considerable percentage of the surplus bran. They told me the rather curious and unexpected fact, that by doing this and sifting out the branny particles, they could get more loaves of bread to the hundred pounds of flour than by using the whole, unsifted flour. So that it went just as far, and the men liked it very much better.

Indeed, the experience of the Army is beginning to raise a doubt in the minds of thoughtful supply experts and Army doctors as to the real and fundamental economy of the eighty-five per cent war-bread flour. One half of the eight per cent saving supposed to be effected by it is known to consist of fragments of the husk of the wheat berry, which are entirely indigestible in the human stomach. As these fragments are not only incapable of assimilation, but set up an irritation in the stomach and intestines, with or without diarrhoea, which sweeps away more than their own bulk of the digestible elements of the flour unutilized, it is an open question whether the

saving supposed to be effected by their retention is not a fallacious one.

It would be very helpful to have careful experimental tests made upon squads of students or soldiers or other volunteers to see whether this saving is a real or an imaginary one, and also to test whether, if a given amount of eighty-five per cent flour were sifted before being made into bread, more loaves of the latter would be eaten per week than of the unsifted flour. Our American experience has shown that it is better and wholesomer to sift out most of the bran and middling, and then dilute this white (seventy to seventy-five per cent) flour, with the desired proportion, usually about twenty-five per cent, of substitute flours from barley, rice, or corn.

The third element of importance in the soldier's diet in keeping up his superb health and high degree of resistance against disease has been the sugars and their recognition as a real food. In every Army ration, on every mess-table, on the three Western Fronts, sugar in some form — fruits, dried, canned, or preserved, or syrup — has been made a regular and substantial feature.

The craving, gnawing sense of hunger for something sweet which comes over a man after two or three weeks of the old-style Army or lumber-camp or cow-camp dry ration, is not only almost irresistible, but a sound and wholesome instinct. The first

and most intense craving of our cowboys, our lumberjacks, and our miners, when they come down to the little frontier towns, is for canned peaches and pie and sweet cake, their second for whiskey.

There can be no question that the remarkable sobriety of the huge armies of this war, the rarity of alcoholic excess among our soldiers, has been closely connected with the abundant and varied supplies of that other "readily assimilable carbohydrate," sugar, either straight or in the form of dried fruits, preserves, biscuits, or syrup, in the ration. And the keenest craving of our boys on coming out of the trenches is for chocolate, doughnuts and pie, in providing which, at whatever risk, the Y.M.C.A. secretaries and Salvation Army lasses are winning their way swiftly right to the heart of the army.

A partial exception to this general sweep of triumph over tuberculosis would appear to be the French Army, in which, particularly within the last year or year and a half, a considerable number of cases of tuberculosis have been reported. The numbers have been variously estimated at from fifty thousand to one hundred thousand cases, — Armand de Lille, who speaks with authority, says eighty-five thousand, — but while these figures look large in the mass and taken alone, when they are placed against a background of nearly six million men and figured out on a percentage basis, they show only about the

figure which might be expected of men of these ages in civil life in time of peace. Even the larger estimate would figure out only about one and a half per cent, while the frequency of tuberculosis in industrial life at military ages is believed to be between two and three per cent. The only reason why tuberculosis in the French Army attracts attention is that all the soldiers have been kept under constant medical observation and every case reported and dealt with, either by discharge or by treatment in a sanatorium, so that the whole world is made aware of it. A similar study of the same number of men in peaceful pursuits in any one of the neutral countries, for instance, would probably have uncovered quite as many cases of tuberculosis, only, as the old proverb has it, "What you don't know does n't worry you."

An excellent and well-arranged system of special hospitals and sanatoria for tuberculous soldiers has been planned by the French Government, and an important division of the American Red Cross, backed by the Rockefeller Institute, is coöperating with them splendidly in giving these stricken defenders of their country every possible attention and chance of cure.

A genuine exception to the general rule is among the French prisoners in the German prison camps, who appear to be showing a high rate of tuberculosis, due to their wretched diet and cruel and disabling treatment, deliberately planned to break down

their health and destroy their future fighting power. Also the unfortunate inhabitants of some of the war zones just behind the Western Front. By the steady and ruthless policy of constant and indiscriminate bombardment of everything that their guns or airplanes can reach, particularly with gas-shells, the Germans have driven tens of thousands of these unfortunate people to live a considerable part of their day and the whole of the night in cellars and caves and underground shelters: with the result — which need surprise no one — that examinations made by various civilian relief organizations of the women and children of these regions show an appalling amount of tuberculosis, ranging in some instances from forty to sixty per cent of those examined. But this, of course, is only a part of the general policy, openly avowed by the German commanders, that they are making war, not only upon the French Army, but upon the entire French nation, men, women, and children.

Curiously enough, such civil statistics as are available in France seem to show that in the mass of the country, taking Paris as an example, there has been not only no increase in deaths from consumption, but an apparent decrease. In Paris, for instance, according to the reports, there has been a diminution in both the total number, and proportion per thousand living, of nearly ten per cent between 1913 and

1916. While, of course, too much confidence cannot be attached to these figures, on account of the tremendous fluctuations of both population and proportions of various age classes, yet it is in keeping with the general death-rate, which shows a similar decline, as reported, of about six per cent.

One of the most consoling features of this terrible war has been the way in which, on account of its being waged chiefly by machinery, elaborate mechanical contrivances, and munitions, it has, instead of diminishing industrial activity and output, increased it, and has provided abundant occupation and higher wages than ever before known for practically every man, woman, or child of the civil population who is able to work. So that the masses of the people — and this is true not only of England, but of France and Italy — have far more money to spend, and are consequently better fed, better housed, and better clothed than ever before in history.

After rather careful and fairly extensive observation, I can say that I saw no signs of injurious food scarcity or of underfeeding in any part or in any class of England, France, or Italy. Food is high, but wages are higher.

There has always been a considerable amount of tuberculosis in Northern and Northeastern France in the coal-mining and industrial populations, though no higher than in similar regions in Germany and

other European countries. So that hundreds of thousands of soldiers must have entered her armies carrying dormant foci or smouldering embers of partially healed tuberculosis in their lungs or glands. There was no time to make elaborate medical examinations; every man able to shoulder a rifle and march a couple of miles had to be flung into the ranks to stop the onrush of the Beast and save civilization from the Hun.

A considerable number of these men in the milder forms and earlier stages of the disease were stimulated and built up by the outdoor life and good feeding and secured a cure, or at least long-continued arrest, of the disease. Another moiety were temporarily improved, but were unable to bear up under the long-continued strain of the hardships and discomforts of the trenches, so that, about the close of the second year of the war, they began to break down and develop a relapse of their ancient trouble, and the Army Medical Boards, having had time to get their breath and complete their organization, started on a thorough investigation of all the "reformés," as the French call those who are invalided out of the Army, and naturally discovered a considerable number of these war-strain tuberculoses.

They faced the situation with admirable promptness and intelligence. An excellent system of both tuberculosis hospitals and open-air rest-stations for

the consumptive "reformés," was organized and equipped, one for each of the larger departments of France, and provision was made for special care and feeding for the graduates from these institutions after they had returned to their homes.

But, of course, this all meant publicity, and the German propagandists and sympathizers all over the world, particularly in America and Switzerland, and the "Defeatists" in France, fairly leaped at the chance and filled the press and the air with the wildest rumors and most unprincipled falsifications. The French Army was simply melting away with tuberculosis, a quarter of a million, half a million, a million cases had already been discovered, and at least as many more unrecognized cases were in the ranks. The real and innate decadence of the French nation had at last revealed itself, ran the canards, and if the war lasted for two years more the country would be depopulated by tuberculosis!

Unfortunately, some of the friendly medical experts from the Allied countries, who visited France to see how they could best assist her in her campaign against the disease, reported that the condition was a serious one in certain regions and industries, and this again was eagerly seized upon and unscrupulously exaggerated by the enemy.

But the French authorities kept their heads, calmly went on with their well-laid plans, accepted cour-

teously and gratefully the proffered assistance from their Allies, and proceeded to make the widespread interest and deep concern over the ravages of tuberculosis, stirred up by the war and its developments, the basis and excuse for a broad, magnificently conceived, nation-wide campaign of education and prevention against this dread disease.

Several of the provincial cities of France, notably in the Department of the Loire, had established before the war admirable systems for dealing with tuberculosis, consisting of dispensaries, children's clinics, open-air schools, open-air sanatoria for the curable, and hospitals for the advanced cases of consumption. The organization of the Department of the Loire excited the admiration of all the English and American tuberculosis experts who visited it. It had nine tuberculosis dispensaries, a sanatorium with four hundred beds, and a model farm attached to it, an open-air country school for children, two hospitals for consumptives, and a training-school for tuberculosis nurses.

This is to be taken as a model by the Minister of the Interior, and similar systems are to be developed in at least half of the larger provinces and departments of France, which will be linked up with the sanatoria and the hospitals for soldiers discharged from the Army on account of tuberculosis. As a result, by the close of the war, the French will have

a chain of these sanatoria and hospitals all over the country, linked up with the local dispensaries and hospitals and the children's clinics, which will be adequate to provide for the needs of the entire civilian population. In consequence, there will, within a very few years, be far less tuberculosis in France than there was before the war, and it will be quite possible within twenty years to save almost as many lives from tuberculosis as have been so deplorably sacrificed on the battlefield to the Hun greed for conquest. Our American Red Cross and a special commission of some of the most skilled and competent experts in tuberculosis, supported by the Rockefeller Foundation, are most liberally and helpfully collaborating with the French authorities in this magnificent work. And just recently they have equipped and sent out a similar commission to conduct a campaign against tuberculosis in Italy. So that war is not quite all hell.

XVII

THE PLAGUES OF ARMIES

TWO great plagues have ever swept close in the wake of war — drunkenness and venereal diseases. Mars, Venus, and Bacchus have always been closely grouped together since the days of the old mythologies. From one point of view, their importance has been usually exaggerated and overestimated; as destroyers of life and decimators of peoples they are among the feeblest and most trivial of the pestilences that riot in the soil turned up by the war plough.

Typhus and typhoid killed at least a hundredfold as many as both drunkenness and dissipation; malaria and pneumonia each fifty times as many; the little bugs that get into the wounds and cause septic or surgical infection were at least ten times as deadly. The main reasons why these twin plagues stand out in such bold and vivid relief among the evils of war is, first of all, their dramatic and striking character; second, that they are due to factors which are under the control of the individual sufferer; and, third, that they continue to curse and vex not only the community after the war is over, but future generations as well. The soldier who dies of typhus or typhoid

in the tented camp, or of gas-gangrene or septic infection in the field hospital, has incurred not the slightest element of blame or reproach; on the contrary, he has bravely risked and lost his life facing the risks and horrors of the war, and his memory is revered as that of a hero and a true patriot. But the soldier who comes home from the war with a habit of alcoholic excess fixed upon him, or with the infection of one of the venereal diseases which he proceeds to spread through the community and to pass on to his helpless children, is a living shame and a perpetual menace and burden to his family, his friends, and his country.

This present war, terrible and world-wide as it is, and destructive upon a scale never before known in history, has shown certain remarkable redeeming features which strengthen the hope of its ushering in a new and higher type of civilization, a lasting victory of humanity over the beast. High among these stands its wonderful success in dealing with and preventing disease. Typhoid has been almost wiped out by the anti-typhoid vaccine; typhus, wherever it showed itself, stamped out by destruction of the vermin which alone carry it; dysentery and diarrhoea, reduced to the vanishing point by fly-fighting, scrupulous purification of water, and protection of food-supplies; tetanus (lockjaw), prevented by the routine use of the anti-toxin; and surgical skill saves ninety

to ninety-five per cent of all the wounded who survive six hours.

Why should not drunkenness and syphilis follow suit with the other diseases and be wiped out as well? There is no reason whatever why they should not if we fight them as vigorously, as intelligently, and as openly as we have typhus and typhoid and tetanus. Indeed, the first of these two Unheavenly Twins has been most successfully attacked already. Not only has the world never seen an army so free from disease as the one under arms at present, but also it has never seen an army in the field so sober and so free from disorder and crime.

The unexpected has happened by an almost incredible paradox. Instead of the world having become more drunken in time of war, it has become distinctly and strikingly more sober. More progress has been made toward the lifting of the curse of drunkenness, in Russia, in France, in England, in three years of this war than in any twenty preceding, and now the United States has swung into line by the vote in Congress to stop, in 1919, the manufacture and sale of alcoholic beverages during the war, as a means of saving valuable grain for our food-supply. By a curious coincidence, which is anything but accidental, the Central Powers are as barbaric and as reactionary upon this issue as upon all the others involved in the war.

The German Army must have its beer regularly just the same as the rest of its supplies, and in liberal quantities, and the quarters where a German officers' mess has been located can always be recognized by the piles and heaps of empty wine and beer bottles which surround it. Which accounts for part of the bestial conduct of all ranks toward the unfortunate captives that fall into their power, particularly women and children.

It is one of the most astonishing and encouraging features of this war that you can walk for hours in the afternoon, evening, and till late at night, through the streets of English cities, or French villages, fairly swarming with soldiers, French, English, Canadian, Australian, Russian, Italian, Moroccan, and never see a drunken or quarrelsome soldier. Here and there you will come across one who is a trifle exalted and anxious to explain to an admiring public what a fine fellow he is and what a splendid regiment or country he belongs to. But even he is a rare exception and is always under the anxious and parental care of at least three or four of his comrades, who are trying to keep him quiet and to get him home to his quarters as quickly as possible. To be seen drunk in public is evidently regarded as both very bad form for the individual and reflects discreditably upon the regiment. This natural tendency of the soldier toward restraint and self-respect has been greatly helped by the most

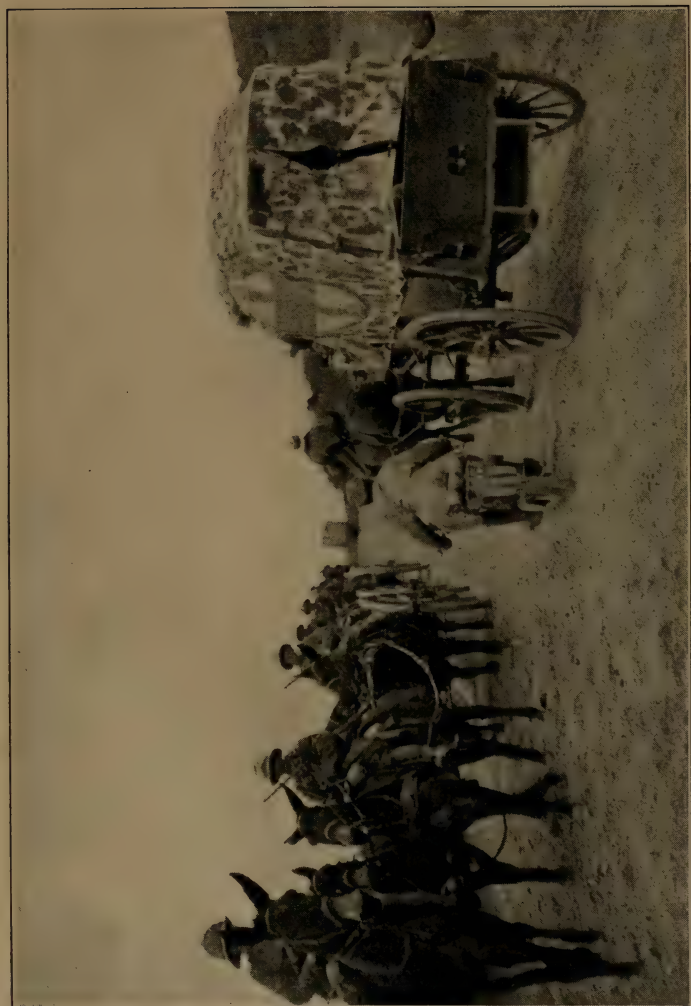
sensible provision in both England and France, making it a punishable offense to offer a drink of any kind of alcoholic beverage to a soldier or sailor in uniform, in any public place.

What is even more incredible, in London, in war-time, crime has fallen to far the *lowest level that has ever been known* since records have been kept! And this with the streets swarming with hot-blooded, adventurous young fellows, not only from every corner of the United Kingdom, but from every quarter of the world, many of them back, for a week's leave and breathing spell, from a bloody and dangerous battle front, and anxious to get the utmost pleasure and relief possible from the stern privations they are going back to, and those streets in more than semi-darkness all night long.

This new standard of the Army has had a great influence upon that of the general public — partly because so many men are in the Army, and partly because of the admiration of everything military which develops in war-time. As a result, combined with higher wages and better living conditions, the amount of alcoholic excess, as measured by the arrests for drunkenness, has fallen off sixty per cent since the beginning of the war. Lord D'Abernon's latest report, as Chairman of the Liquor Traffic Board, declares that drinking in England has diminished eighty-five per cent!

So that venereal disease is the only one of the plagues of war which lags behind, and already a most encouraging beginning has been made against that. The movement had started some two or three years before the war, partly as the result of the general awakening and enlightenment of the public health conscience; partly, and even more powerfully, because for the first time in history we found ourselves in possession of a remedy which would not only cure the disease within a reasonable length of time, but, what was more important, would make the patient *practically safe, and harmless, as a further source of infection*, within a few days. This was the now famous "606" or *salvarsan*, as its name implies, an ingenious combination of arsenic.

This wonderful boon will cure, roughly speaking, eighty per cent of all cases of syphilis in from three to five months, and, what is far more valuable from a preventive point of view, clears the spirochetes or germs of the disease out of the blood *within forty-eight hours of the first injection!* This disappearance is not permanent, as a fresh crop of the germs will reappear in a month or so, from seed-germs which have taken refuge from the poison in the deeper parts of the body, probably the glands and the marrow of the bones. But it means that if the victim of syphilis is promptly discovered and treated with *salvarsan* and then kept under observation at monthly inter-



AMBULANCE AND DISPATCH-RIDER COMING FROM A BATTLE ON THE SALONICA FRONT

vals, nine tenths of the risks of his spreading the disease will be wiped out!

Incidentally, this is just as much for the advantage of the patient as it is for that of the community, because the rapid destruction of the spirochetes by salvarsan not merely stops his infectiousness to others, but also prevents the further development of the disease. So that, in the majority of cases, the dreaded rash and ulcers in the throat, and the falling of the hair and destruction of the bones and involvement of the nervous system (locomotor ataxia, paresis, etc.) are completely prevented. It is hardly too much to say that the patient who discovers that he has been infected within a month or even two months of his exposure, and takes salvarsan, will, eight times out of ten, never know that he has had syphilis.

Naturally this encouraged health authorities and physicians to move actively for the prompt recognition and reporting of all cases of syphilis, with public provision for its treatment, if necessary, without expense. One of the ablest and most careful studies of the question was that made by the English Royal Commission on Venereal Disease appointed in 1913, just a year before the war. After studying the problem very thoroughly and intelligently for two years, it was ready to report, but hesitated for some time because, the war being then in full swing, it feared that either little attention would be paid to the report,

or that nothing could be done to put in force its recommendations.

However, in the second year of the war it decided to risk it, and much to every one's surprise and gratification, it found both the public and the civil and military authorities in a most receptive frame of mind. Most of its practical recommendations were adopted at once, without waiting for the action of Parliament, where bills were introduced in both Houses to improve the laws dealing with the situation.

Now the health authorities and officials of all parts of England are prepared to offer to any persons who suspect that they may have become infected with syphilis, first, a free examination of their blood, by the Wasserman test, or the Noguchi test, which will determine positively whether they have syphilis or not; second, if the infection is found to be present, free treatment with salvarsan by competent experts for as long as may be necessary to complete the cure, and without expense to the patient.

A similar arrangement has been established by the Health Department of New York City, for four years past, and is giving admirable results. Or was, until the New York County Medical Society, to its lasting shame, rose up in wrath and demanded that the free treatment be stopped, because it was taking money out of the pockets of the doctors — or, as they put it, the bread out of the mouths of their families!

Much, of course, remains to be done, principally in three directions: First, education of the public, and particularly of the young, including a new standard of biological morality; second, making the matter first and foremost a public health problem, and getting rid, as far as possible, of the sense of disgrace and special culpability and concealment about the misfortune; third, dealing with the prostitute as a clearly mentally defective class and a permanent menace to the community.

The first of these aims — education — is rapidly being attained; one of the most valuable and unexpected results of the report of the English Royal Commission was the full, thorough, and sensible discussion of it which was given in all the daily papers. Not only was the majority of the report published in full, but editorial after editorial appeared in the most sacred columns, calling attention to the dangers of neglect and delay, and even mentioning syphilis right out by name in public — which was little short of a miracle, considering the traditional attitude of both the British public and the British press upon this subject. And after some hesitation the Army authorities took up the problem in the training-camps in the same spirit, with most gratifying results. Talks were given, first by the Army doctors and then by special medical lecturers who volunteered their services, clearly and frankly describing the nature and risks of

symphilis and gonorrhœa, and the means of their prevention, with special emphasis upon the fact that sexual indulgence is not in the least necessary to health, and that the greatest menace of such illicit pleasure is to the welfare of the next generation.

The importance of this victory over stupidity and nasty-mindedness, calling itself modesty, can hardly be overestimated: first, because the judgment of average humanity is surprisingly sound and sensible when once it has the proper knowledge on which to base it; second, because the young are cleaner-minded and more decent and sensible about these matters than the middle-aged and the old, popular delusions to the contrary notwithstanding.

If we would stop preaching at our boys and girls about these matters, simply tell them the facts and let them form their own conclusions as to the wisest and most honorable course, we should get far better results. The dangers of the adolescent period have been enormously exaggerated, and our hysterical descriptions to boys and young men of the terrible temptations and fierce struggles with their instincts, which they are sure to experience if they attempt to behave themselves decently and sensibly, do far more harm than good. It is distinctly doubtful whether adolescence is the period of severest temptation in this regard; that is to say, in proportion to the deterrent and counter-balancing influences. Cer-

tainly the large majority of those who are brought before our courts of justice for sexual offenses are middle-aged or older. And the chief financial support of the red-light districts and the adventuress class comes from so-called respectable, middle-aged married men, and not from the age of youth and adventure and romance: the young have so many more keen interests and sources of pleasure in life.

Even more deplorable is the other traditional assumption that it is not only natural, but necessary, for young men to sow their wild oats, to go through a period of experience and adventure in the knowledge of good and evil: in fact, that their experience and development are not complete without it. This vicious delusion did not originate with the young, nor is it generally believed by them until it has been dinned into their ears by the wisdom of their elders. It was invented by bald and graceless burgesses of the fifth and sixth ages of man, in order to put a halo around their youthful adventures and follies and render them suitable for framing in their chuckling memories.

Whatever its origin, it has been responsible for probably as many wrecks and misfortunes and shame as all the hot-blooded and uncontrollable impulses of youth put together. It is precisely of a piece with that other abominable social tradition that a boy cannot count himself a man until he has learned to

drink and been at least once or twice under the influence of liquor. The quicker both of them can be thrown into the limbo of exploded superstitions, the better, and there is where the Army has flung them. There is not a shred of foundation or basis in either science or common sense for either. That there is an instinct and a powerful one urging in this direction is perfectly true, but that instinct is for the benefit of the race and not of the individual, or, to put it more precisely, it is only when it is helpful to the race that it is of benefit to the individual.

Another position which we have assumed toward this group of diseases is, I think, unwise, and ought to be modified. That is the attitude of profound disgrace and moral delinquency which we have visited upon their unfortunate victims. It is quite true that there is an element of moral responsibility and blame for these diseases, because they are largely due to circumstances and actions which are more or less completely under our own control, and we are justified in laying a reasonable emphasis on this. But, after all, that responsibility is only relatively greater than that which exists in a great many other diseases, which come from the violation of known laws of conduct and of health. Indeed, in not a few cases it is no greater, on account of the dense and lamentable ignorance of these subjects in which our traditional ostrich-like education has kept the young.

At all events, the most rational as well as the most humane and helpful course is to waive this overdone attitude of disgrace and moral reproach and to regard the unfortunate victims of these diseases as patients who ought to be cured as promptly as possible and wards of the community who need help rather than scolding and denunciation. Our first duty as physicians, parents, and philanthropists is to cure them first and to leave the preaching till afterwards.

Every appeal, every address to boys on this subject ought to make it perfectly clear that if ever, in spite of knowledge and good advice, their impulses should get the better of their judgment and they should find themselves in trouble, they are to come at once to their nearest relative, friend, or adviser and make a clean breast of it, and they will be neither punished nor scolded, least of all turned away unhelped, but will be simply put under the best care and in the way of cure at once. There is no use either crying or scolding over spilt milk, and there cannot be the slightest doubt that the vivid dread of parental or other wrath and denunciation furnishes one of the richest fields of harvest for the quack and the charlatan and the blackmailer. Many and many a young fellow who finds himself in trouble avoids and keeps away from the competent expert or reputable physician whom he knows and has confidence in personally, particularly one who is acquainted with members of

his family, on account of this dread of disgrace and humiliation, and resorts to the advertising blood-suckers and blackmailers, who of course seek his confidence only for the purpose of threatening to betray it and exploit his dread of exposure for all that it is worth. If parents would make this perfectly clear to their sons, if guardians would assure their wards, if the modern type of intelligent employer would make it clear to the men and boys in his employment, that if they come to him promptly and frankly as soon as they find themselves in trouble, he will regard them as sick first and sinners afterwards — perhaps, it would enormously help in the battle against these evils. And this is exactly what the Army medical authorities have done.

Nor would it lower the standard of true manhood or moral responsibility one whit, for how many of us are there that are so entirely without sin that we can afford to cast the stone of reproach and condemnation? The boy who has been saved by prompt and kindly help from a lifelong menace or a lasting blood taint, threatening generations yet unborn, will be far more likely to heed the counsels of wisdom in future, and to exercise a helpful influence among those of his own age, than if he had been left to bear the penalty undiminished and the disgrace unaided. Yet to such an extreme have some of our self-styled moralists gone in this respect that they have actually

decried the use of salvarsan and denounced the use or knowledge of preventives of infection, on the ground that he who has sinned ought to be allowed to bear his punishment as decreed by an All-Wise Providence!

Last and not least important comes the frank recognition of the prostitute, not as a "fallen sister," or an impulsive, romantic victim of emotionalism and love of pleasure, but as a poor, stupid, unfortunate feeble-wit, without the slightest conception of what either romance or adventure means, earning a pitiful and sordid living by the exploitation of her only gift, her sex, simply because she is too stupid and too incompetent to earn a living in any other way.

Expert mental examinations of thousands of these poor creatures have shown two thirds to three fourths of them to be clearly and hopelessly feeble-minded, their average mental age being about that of a child of eleven. They should be regarded as wards of the State and protected against themselves and their filthy and contemptible exploiters, by education in beautiful school colonies in the country, until they are forty-five. They could be detected in advance by simple mental tests at from nine to twelve years of age, and with their segregation would disappear from half to two thirds of the wretched traffic of which they are the vehicles.

It is coming to be the judgment of intelligent chiefs of police, vice commissions, and other students of the problem, that the prostitute and the red-light district create at least two thirds of their own trade. The whole deplorable affair is a business, carefully organized, advertised, touted for, run hand in glove with the saloons, and instinct or passion of any sort has astonishingly little to do with it. The only people who make money out of it are the men who control it and not the wretched women; and movements for its control and abolition are fought most viciously, not only by the brothel-keepers, but by politicians, pillars of the church and society, merchants and property-owners, who make enormous profits out of its supplies and huge rents out of its houses. At all events, boys and young men, both soldiers and civilians, should clearly understand that the woman or girl, whether professional or amateur, who offers them an adventure of this description, is nine times out of ten after their money and nothing else.

Against dissipation and venereal disease the best antidotes and preventives are plenty of intelligent, wholesome amusements of all sorts, particularly athletics and dances or other forms of social entertainment, under proper auspices. It is the clear duty of the community to provide ample opportunities for this free, happy, helpful social life among its young people, either through the church social, the school

party, or the municipal dance or reception properly chaperoned, both for their health, happiness, and refinement, and as an aid to the romantic and delightful, but immensely important and serious, enterprise of choosing their partners for life.

If boys and young men have plenty of good women and girls to associate with, they'll never miss the bad ones. In our American Army, both in the home cantonments and in France, provision is made for this most necessary and invaluable influence through the admirable Hostess Houses of the Y.W.C.A., the Red Cross, and other patriotic organizations.

In this broad and intelligent spirit venereal disease has been attacked in the armies, and the result has been a very triumph of common sense. From the earliest days of his training the recruit is thoroughly and carefully instructed as to its nature and dangers, either by the regimental surgeons or by specially skilled speakers who make the round of the cantonments. He is put in full possession of all the facts, the dangers of disability and disease emphasized, and then his patriotism as a soldier who must keep himself fit, his self-respect and his regard for the future of the race, are appealed to. And superbly has he responded.

In spite of all the special temptations that assail the soldier in the camp and in the field, the rate of venereal diseases in the Allied armies is now *less than*

half that believed to exist among young men of similar ages in civil life. The disease has been met frankly, not only as a moral problem, but as a sanitary one, taking every known and effective means of preventing or curing as quickly as possible one of the most disabling diseases to which soldiers in camps are liable.

That the risks of exposure to those diseases should *not* be run is accepted without question, but it is held that, in the language of a famous President, "it is a condition, and not a theory, which confronts us." And if once the risk has been incurred, the soldier is not merely instructed what to do, but provided with all the necessary means for avoiding an infection.

Prophylactic stations, with hospital orderlies in attendance, have been established, not merely in every camp and camp hospital, but in our American Army in France in every Y.M.C.A. building, so that the fullest opportunity is afforded to every man to save himself. If the soldier reports and avails himself of these facilities, even if he should later develop an infection it is counted only as a minor misdemeanor; if he does not so report, his pay is docked during the whole time that he is under detention and treatment.

What is even more effective, the men who develop these infections are held under constant surveillance in a sort of movable quarantine under military guard.

They live and eat and sleep in a special hut; they are marched out under guard for special details of work, separate from the rest of the men; they march back to their barracks in the evening and are locked up for the night.

The conduct of the other troops toward this venereal squad (only it is called by a shorter and much less polite name) is sadly lacking in brotherly consideration and Christian charity, and the fire of humorous comment to which they are subjected as they march about under guard is not exactly soothing.

This method, which is carried out most perfectly in our American Expeditionary Forces, works so well in practice that at the time of my visit it had actually reduced the percentage of venereal disease, in a body of nearly 30,000 troops, to *one half of one per cent!* And the latest report of the Special Army Commission on Control of Venereal Disease, in May, 1918, is that out of half a million men in France only one tenth of one per cent are under hospital treatment for social diseases.

When this is contrasted with the old peace average for the English Army, about six per cent (to say nothing of the fifty-year-ago averages, which used to run to twelve or fifteen per cent), and that the best ever attained before was two per cent in the French Army and one and three tenths per cent in the German, and that these latter figures only included the

men who were sufficiently disabled to be confined to the hospital, it will be seen that the method is not lacking in practical effectiveness.

In addition, the American military police have the power, in the name of "*la défense nationale*," promptly to deport from the Army zone, without trial or other troublesome legal delays, all women known, or reasonably suspected, to be prostitutes, who have come into it since it was occupied by the Army. If London would tackle the problem in the same spirit, the disgraceful and deplorable scenes, which are the open scandal of the streets leading to most of its great railway stations by which troops enter the capital, would soon be wiped out. If any pretext save that of the defense of the realm was needed, it could be found by merely making a thorough mental examination of these unfortunate women and then applying the provisions of the act for the protection of the feeble-minded, as from seventy to eighty-five per cent of them have only the mental development of children of eleven.

XVIII

THE EFFECTS OF WAR ON THE CIVIL POPULATION

ONE of the most singular and sinister ironies of war is that its heaviest slaughter is not upon the battle-field. Famine at home and pestilence in the tented camp have ever slain from ten to twenty-fold as many as the clash of arms upon the open field. It is the men who make the wars, and the women who pay for them.

In earlier wars the calling-away of all men of military age to the front meant, when most countries were from one half to two thirds agricultural in their population, the tilling of the land only by women, children, and old men, with immediate scarcity of food, the shutting-down of such factories as existed on account of the lack of raw materials as well as labor, which meant unemployment or low wages, all over the land less money to spend, and all food and necessities double or treble their former price. Bread riots were as regular an accompaniment of former wars as bugles were.

Consequently, one of our keenest interests as both statesmen and students of social conditions, when this terrific calamity broke over an unsuspecting

Europe, was, what would be the recoil of the war gun upon the stay-at-homes; how would the civil population stand the strains and stresses of war conditions? When I went abroad in January, 1917, after a state of war had existed for over two years, one of my deepest interests was the study of the actual effects of war upon national vitality, its reactions upon the nine tenths of the people of the Allied countries who remained at home, rather than its more direct and obvious effects upon the one tenth who were on or near the fighting-line. For the reason, not merely that, forming so vast a majority of the nation, whatever affected them, even in less striking degree, was of even deeper vital importance than the fortunes of those in the trenches; but also that any results, for better or for worse, wrought among the home population would be likely to be permanent and to deeply affect the future history of the race, while those wrought on the battle-field, though more dramatic, might be much more transient in character.

Besides, the utmost results to be hoped from triumphant victory in the war itself were so meager, so pitifully inadequate to repay the blood and agony which they had cost: merely a return to the *status quo*, to the position in which the world fondly believed itself to be in the fatal summer of 1914, when reason, humanity, and justice were supposed to govern the nations: the chaining-up of a homicidal lunatic nation,



CANADIAN WOUNDED GOING TO THE DRESSING-STATION ON A LIGHT RAILWAY

that we did n't even know was crazy, the safeguarding of civilization and democracy from a menace of barbaric world conquest that we could hardly believe existed. Perhaps the reflex results at home might show a more positive gain, a less barren triumph, some return even partially worth while for the wastage and horror of it all.

Of course, the fortunes of the home population are far less dramatic and unusual and attract much less public attention than those of the armies. From the beginning the columns of the newspapers have been crowded with the most detailed reports of this battle and that skirmish, with their pitiful lists of the killed and the wounded, with all the news of camp, of hospital, of troop-ship, and the murderous marvels of howitzers, machine-guns, and bombing airplanes. But only a line here or a paragraph there reports the welfare or ill-fare of the nine tenths who toil patiently at home, growing the food, forging the guns, turning and filling the shells, weaving the clothing and stitching the shoes, building the ships and manning the railways to supply and support the one tenth in the world's eye at the Front.

But this comparative scarcity of news as to the conditions among the people at home was really in itself an encouraging sign. Prosperity and well-behavior seldom make good copy, and only misfortunes or misdeeds catch the eye arrestingly in the

headlines. "Happy is the nation that has no history" was shrewdly true in the sense that history is or was largely made up of records of wars and kings and other calamities. If there are no strikes, if there are no bread riots, if there are no famine-bred pestilences to claim prominent space in the newspapers, the hopeful presumption is that the great working mass of our population is faring better than usual in war-time.

Within a week of the time that one lands at Liverpool or steps upon the historic soil of France, one becomes aware by many significant signs that this present war presents almost as many differences at home from conditions obtaining in former wars as have been noted in the trenches. It so happened that I had made various trips abroad for the purpose of studying different health conditions, remaining for two different periods of nearly two years each, so that I was reasonably familiar with the physical and hygienic conditions of the English, the French, and the Italian peoples; and I was instantly struck, on reaching the streets of Liverpool, with the fact that I had never seen the mass of the English people looking so well fed, so well dressed, and in such good general physical condition.

Inquiry among my friends, both in industrial life and in the professions, particularly among the health officers, almost universally confirmed my first impressions. The death-rate, instead of being higher,

was the lowest in years, in fact, had only once been surpassed. Instead of a good deal of malnutrition and diseases due to underfeeding among children, the infant mortality and child death-rate, after a distinct rise during the first six months of the war, had begun to decline and was now at the lowest level ever known.

Instead of unemployment, there was an actual excess of jobs over applicants; wages had risen so that families were earning more money than they ever had in their lives before. And the one complaint that was uniformly voiced by my middle-class friends and acquaintances was that the working people were buying things they had never dreamed of possessing before, such as pianos, organs, plush upholstered furniture, ostrich feathers, and even furs and jewelry.

More unexpected yet, vagrancy was almost unknown; the poor-houses were half-empty; drunkenness, as indicated by the number of arrests, had fallen off from thirty to fifty per cent, and crime had decreased in the most astonishing fashion, even in spite of the fact that a large proportion of the younger and more active policemen had gone to the Front and that the streets of all the cities were in a state of more than semi-darkness at night. Even though the spokesmen of the upper and middle classes were all firmly convinced that the working classes were getting far

higher wages than they were worth, and in the beginning of the war had loudly lamented that they would surely spend the greater part of the surplus on beer, they were now admitting that their prophecies in this regard had been largely unfounded, and that most of the munition workers were putting their high wages into more nourishing foods, better houses, more attractive clothing, war bonds, and savings banks.

When I had finished my stay in England and crossed over to France, I found an almost parallel situation existing there as to the physical and financial welfare of the great mass of the people, only in less degree. This was, of course, to have been expected on all grounds, partly because France has much more largely a farming population, and hence there had been an earlier and more striking falling-off of and restriction in certain classes of food-supplies, while at the same time a much smaller portion of the population was benefited by the great increase in wages. Also because heroic France had borne the full brunt of the war right from the very beginning, while it had taken England a year and a half to put even an approximately large proportion of her population into the field. Nevertheless, the shops were all open and their windows crammed with goods, trade and traffic were good, labor was scarce, wages were more than doubled, the people were well dressed and

well fed, and that most sensitive barometer of national welfare, the children, were bright-eyed, plump-bodied, rosy-cheeked, and strenuous of both voice and limb in their happy play.

Again, inquiry among officials, business men, physicians, and social workers corroborated these impressions with certain exceptions. There had been a slight increase in the civilian death-rate, an apparent increase in tuberculosis, an increase in the infant and child mortality rate along, and from ten to fifteen miles back of the Front, on account of the indiscriminate nature of the German bombardment. But when all was said and done, the civil population of France was holding its own, not only with magnificent courage and unconscious heroism, but also with most gratifying and surprising physical and hygienic success.

One reason for this cheering and unexpected state of affairs on both sides of the Channel was not far to seek. And that is the extraordinary degree to which this war is being fought by machinery. The whole of the Western Front in its four hundred and thirty miles, from the sea to the Alps, fairly bristles with machinery and literal engines of war of every description, from the trenches clear back to the supply areas and the bases. Every highroad leading to the Front is as crowded with high-powered motors and camions as a railroad roundhouse is with locomotives. Our

fighting men march by machinery, dig with machinery, fly by machinery, and shoot by machinery; they do everything by machinery except eat and sleep and swear. So astoundingly dependent have they become upon mechanisms of every imaginable sort, that it is actually proposed to utilize chilled-steel automatic soldiers, mounted with rifles, whose fire can be directed from a safe distance, capable of rising up to shoot and of going down to safe cover, and requiring neither food, nor clothing, nor pay.

This means an enormous and incredibly lavish expenditure of ammunition; more rounds can be fired in a minute by machinery than in an hour by hand as in previous wars. This is not a mere figure of speech; in one single offensive on the Somme, it was stated in Parliament that the British Army had fired *more shells and cartridges of all sorts than in the entire Boer War!* And every army corps of forty thousand men requires one single-track railroad running to its full capacity day and night, just to supply it with ammunition alone.

The result has been that instead of factories shutting down and mines closing and trade stagnating and operatives being thrown out of employment, there has been an enormous stimulation of manufacturing activity along a very large number of lines; and not merely the men who have remained at home, but the women and older children have been fairly

flooded with work at wages beyond even their wildest dreams before the war.

Many a soldier's family, containing one or more children of working age, has two to three bread-winners now, instead of one as before the war, and often each one of them earning more money per week than their father did, so that with the liberal separation allowance from the Government, they not infrequently have from two to three times the income that they had in the days of peace. The result is that the great majority of the working classes, including agricultural laborers, who form in England about eighty per cent of the total population, are spending money as they never did in their lives before. And while naturally some of it goes for feathers and cheap jewelry and taxicab rides and hothouse luxuries and gaudy silks and satins and screaming plush furniture, the bulk of it is going for richer and more varied meals, larger cottages in better neighborhoods, pianos and organs, furniture and carpets, yes, even pictures and china and furs and real diamonds, and, as they begin to sober down from their first delirium of "gold fever," into war bonds and savings banks and building and loan companies.

Even their first delirious delight of spending, what to them was, in classic Johnsonian phrase, "wealth beyond the dreams of avarice," though shocking and simply scandalizing to the outraged eye of the moral-

ists and preachers of economy of the upper and middle classes, had something pathetic about it. One woman munition worker, when her first pay-day came, promptly "blew in" two thirds of her earnings for a pair of pheasants, with hothouse grapes, mushrooms, and guava jelly for her wide-eyed brood. Another, as soon as she actually saw three whole golden sovereigns lying in her palm at once, to spend just as she liked, without fear of remonstrance even from her husband, hailed the largest and most sumptuous public automobile that she could find and piled in her whole tousle-headed, shabbily dressed family for a ride round the parks. Another one marched into a fashionable department store and bought herself a blazing and gorgeously embroidered Japanese kimono, and insisted upon putting it on over her soiled and shabby working dress and wearing it home. Each one of them trying in one reckless, splendid moment to gratify the ambitions, the cravings, the unfulfilled longings of a lifetime, for something supremely beautiful to the eye, soft to the touch, or delicious to the taste. But having once blown off their accumulated steam, their long-suppressed yearnings, in Freudian phrase, "their strangulated emotions," they soon settle down to tamer and more rationally balanced methods of spending. In Matthew Arnold's phrase "the sense in them for conduct, the sense in them for beauty," reached an equilibrium.

This was most interestingly and convincingly shown, in the matter of foods, by actual scientific test and experiment. Naturally one of the first indulgences which the workers gave themselves, when the Big Pay began to come in, was in the direction of their favorite savory and attractive foods, particularly meats, sausages, pies, and rich plummy cakes. Numerous headaches and bilious attacks and internal dissensions of sorts followed at first, but the net result was that they got more real food into their systems, gained in weight, improved in health and strength, and did more and better work than they were capable of before on their old poverty diets. So striking was this last result that the more intelligent owners and employers of munition plants put in well-equipped and attractively decorated canteens or cafeterias, in which they supplied a good variety of well-cooked and substantial foods at cost price, or in some cases actually a little below, so as to encourage their workers to feed themselves liberally and well.

When the committee of distinguished scientists and physicians, appointed by the English Government to safeguard the health of workers in munition plants, came to study the food problem, they decided to test out the self-chosen diets of the workers of both sexes and various ages and see whether they were over or under the amount required for their condition and the work that they were doing, and whether they were

reasonably balanced. The tests were made on quite an extensive scale in a number of different factories, so as to include all classes of workers and conditions of work. In some of them a watch was kept upon the amount and kinds of food that the operatives ordered in the cafeterias; in others, the consent of a certain number of the workers was obtained to allow a visiting nurse to go to their homes and to take a list of the family food purchases for a certain number of days or a week. But the method which was regarded as freest from any possibilities of outside influence or abnormal conditions or embarrassment of any sort, was the simple but ingenious one of stationing a man at the men's and boys' entrance to the factory, and a woman inspector at the women's and girls' entrance, and having them offer every fifth or tenth worker, at random, a dollar for their dinner-pail and its contents, promising to return the pail.

The contents of the dinner-pail were taken to one of the laboratories of the committee and their total number of calories or heat units carefully estimated, and the proportion or balance of the three or four great main food elements, proteins, carbohydrates (starches and sugars, fats, fruit acids, and vegetable alkalies) worked out. Then these were compared with similar findings drawn from the meals ordered in the canteens, and the weekly food bills in the households. Much to every one's surprise and also grati-

fication, the average results from hundreds of cases was that the diets adopted on their own initiative, just simply guided by their own unspoiled appetites, by men at heavy and at light work, by women at various grades of occupation, and by boys and girls, seldom varied more than ten or fifteen per cent from the ideal amount required to keep them in health at their age and character of work! Which is one of the highest tributes to the soundness of our instincts and the good common sense of average humanity that has ever been paid.

There were exceptions, of course, and one of them the committee, with a saving sense of humor, thought worth while chronicling. It was a boy of seventeen, who was making some twenty-six or twenty-seven shillings a week, to his astonished eye almost the equivalent of as many dollars over here. His estimated number of calories required, for age, weight, and character of work he was doing, was thirty-two hundred, while the energy stored under the cover of that single pail represented no less than eighteen hundred calories, no trifles and knickknacks, but good, solid, filling slabs of cold meat and cheese and sausage and plum pudding and gingerbread, with a jam tart to finish up with, whose puff paste walls were three quarters of an inch thick; which, if his other two meals were on anything like as sumptuous a scale, would bring his total intake up to the magnificent sum of

fifty-five hundred calories, nearly double his "text-book" requirements. But what are cold calculations like these in the happy days of youth? The delighted youngster was probably having all he could eat of what his soul most craved for the first time in his young life, and he was making up for years of under-feeding, as well as accumulating a margin for future growth. He was literally "blowing himself," — "doing himself extremely well," in the quaint English phrase, — but he would soon come down to earth again when he had once thoroughly caught up. And the committee specially noted that up to the time of writing his health had not suffered in the slightest, and he was both lengthening and thickening at a remarkable rate, as well as carrying his work successfully.

I talked with scores of employers, superintendents, and foremen, factory physicians, and welfare workers, both men and women, on my numerous visits to the munition works by the courtesy of the British Foreign Office, and they were all unanimous in declaring that, with, of course, inevitable exceptions, the vast mass of the workers, particularly the women and the children, had gained weight, improved in nutrition and appearance, and were in markedly better health as a result of their experience in the factories.

This seemed almost incredible, but it did not take

long to convince me by actual personal observation that it was an absolute fact. The secret of it was, first of all, the right feeling, sound common sense, and patriotic devotion of the overwhelming mass of the workers. Incidentally, it may be remarked that one of the finest things that has come out of this war has been the tremendous respect for both the courage and good feeling of the common man in the trenches, and the good sense and public spirit of the common man and the common woman at home and in the factories, inspired in every one who has been able to observe either of these situations at first hand. It is going to form the basis of an entirely new spirit and relationship between employer and employee, capitalist and laborer, "upper" and "lower." Everywhere one hears the hackneyed but unreserved and expressive phrase, "the men — the women, are simply splendid." Nobody would believe before this trial by fire that there was so much dignity, such sound judgment, such inherent decency and kindness in humanity; and the so-called "lower classes" cordially return the compliment to the upper.

The second great cause why munition works, instead of breaking down the health of women and boys and girls, have actually built it up, rests upon the facts that, first of all, most of the war factories have been new, or so enormously expanded as to be practically so, and so had no bad customs or traditions

to contend with and could be built according to the most modern sanitary and efficiency plans. Second, that they are all under Government control and supervision, constantly open and subject to inspection, living in the full light of publicity day and night. Last and not least, that at the instance of that great democratic statesman and friend of the plain people, Lloyd George, the Government took every possible step from the very beginning, both to safeguard the lives and health of the workers and to see that all controlled factories and other establishments were planned and conducted upon the broadest, most intelligent, and up-to-date industrial and hygienic lines. An admirable and capable committee on the health of munition workers was appointed in the first year of the war, and studied out and published valuable bulletins upon the various problems affecting the welfare of the war workers. The more intelligent and successful owners and employers soon discovered that careful attention to the health and comfort of their employees really paid and was a substantial factor in the earning of dividends.

In one way the factories started under a tremendous handicap, and that was the enormous demand and vital necessity of a huge amount of output in the shortest possible time. It was a wonderful and most crucial test and try-out of the soundness of scientific and hygienic principles of production. | In the first

weeks and months of the war, when every commander was shrieking for shells and rifles and cannon, all rules were suspended, and the workers, in response to the frantic urgings and appeals of both the military authorities and their employers, worked literally all day and half the night, seven days out of the week, and gave up, as a mark of patriotic devotion, even their legal holidays. The result for the first few weeks and months was magnificent. Factories sprang up almost overnight like mushrooms. Utterly new and unskilled hands were broken in to unfamiliar work within a few weeks. A steady stream of arms and ammunition poured across the Channel. But then the strain began to tell. Men began to go stale, to try to whip themselves up to the killing pace with alcohol, actually to fall asleep at their machines or their benches, and one after another to drop out and not reappear next day, and when messengers were sent to urge them to come back, they found that they had simply tumbled into bed, and slept for twenty-four, thirty-six, forty-eight hours at a stretch. What was worse, the quality of production was falling off. "Duds" were becoming more frequent among the shells instead of less so. The men and women workers were getting quarrelsome among themselves and difficult to deal with by their superintendents.

Here was the health committee's chance. They came forward with what at first sight was fairly

scoffed at as a hopelessly heroic remedy, namely, cutting down the hours of work to nine or less a day, restoring the Saturday half-holiday, abolishing Sunday work, and discouraging overtime work as much as possible. The cure looked simply suicidal to most employers, but the situation was desperate, and a few of them were intelligent or reckless enough to give it a trial. To their intense astonishment it worked, just as we doctors had been telling them it would for nearly twenty years past. Men and women who were working twelve, thirteen, and fourteen hours a day, either on piece-work or on output which could be easily counted and estimated, such as shell fuses, for instance, on being cut down to eight and nine hours a day, not only did not lose ground on their output, but actually increased it.

So that England's population is doing its war-work under almost ideal hygienic conditions and hours, and fairly thriving on it, as evidenced by the significant fact that both the death-rate and disease-rate of the entire civilian population, as well as the infant-mortality, have during this war reached the *lowest levels on record in history*, and the total population of England is *slightly but distinctly increasing* year by year, in spite of her terrific losses in the field!

XIX

GUARDING THE HEALTH OF THE NAVY

MAN is by nature an amphibious animal. The famous old sentimental ballad, —

“Sigh no more, ladies, sigh no more,
Men were deceivers ever,
One foot in sea and one on shore,
To one thing constant never,” —

however painfully uncomplimentary it might be in its first and last lines, is absolutely and historically truthful in its third. In fact, his inconstancy might be stated in even stronger terms nowadays, not merely double-faced, but triple-faced, as judging by the success of his recent invasion of still another element, the air, he is likely soon to find himself equally at home in all three.

At present and by comparatively ancient tradition, we have come to regard ourselves as land animals, and having conquered a partial and precarious footing upon the cruel and treacherous sea only at great venture and peril. But as a matter of historic and geologic fact, we were originally hatched just about where the old ballad describes us as still standing, where sea and land meet, and we followed the sea for thousands of æons before we finally turned

our swim bladders into lungs and our fins into feet and clambered up on to the mud-flats for keeps. Then mark how history repeats itself. No sooner did we, in the dawn of that day before yesterday which we call historic times, succeed in conquering the waves and breaking through the encircling barrier of "the white and wailing fringe of sea," by the achievement of what Ruskin describes as man's greatest and most momentous single invention, the ship, a little section of dry land, which would carry its shell-full of precious air skimming across the surface of the deep, than we began to live upon the sea again and to build our towns and our marts, our fortresses and our palaces, our great cities and the capitals of our world empires, upon its salty marge, where their feet could be washed by its ebbing and flowing tides.

One curious illusion, however, still clings to us as the result of our long, long dry spell between the salamander stage and the ship, and that is, that life upon the sea is dangerous and uncertain to the highest degree as contrasted with the peaceful safety of life on shore. All our litanies are full of prayers "for those in peril on the sea." Most of the adjectives which are applied to "the great world mother, mother and lover of men, the sea," are harsh and unkindly ones, "cruel," "hungry," "treacherous," "merciless," "angry," "devouring," "engulfing." Kipling's Norseman's wife cries out to her husband —

"What is a woman that you should forsake her
To go with the old, gray widow-maker?"

And his splendid trumpet song of "England's Dead"
begins —

"We have fed our sea for a thousand years,
But she calls to us, still unfed;
Though there's never a wave of all her waves
But marks our English dead."

As a matter of cold statistical fact, fewer lives are lost at sea by hurricane, by shipwreck, by fire, by hidden reef or uncharted rock, by all the perils of the deep, than are swept away by any one of a dozen of our minor diseases and pestilences. The sailor ranks high in the tables of longevity, only a little way below the farmer and the clergyman; he is in far more danger from fire-water than he is from sea-water, and is an excellent life risk if he only keeps away from the former. On the face of the figures, following the sea is one of the safest and healthiest of occupations, while the actual mortality of all those who go down to the sea in ships, whether as passengers or seamen, is far lower than that of those who remain on shore.

In fact, the attitude of the ancient sailor-man chantey —

"The wind it blew a hurricane,
The sea was mountains' rolling,
When Billy Buntline turned his quid
And said to Billy Bowling,
'Old Boreas is a-comin' Bill;
Don't you hear him roar now?
And don't you pity all poor folks,
That are upon the shore now?'"

is far more rational and in accord with the facts of the case than the traditional sentimental melancholy of the "men must work and women must weep" order.

Of course, there are certain cold-blooded deductions which must be made from these apparent results, such as that sailors consist exclusively of men, the great majority of whom are in the prime of life, and of a considerably higher degree of toughness and resisting power than the average, otherwise they would have been weeded out and discouraged by the hardships which they have to meet. And as regards the floating population having a lower death-rate than the shore one, the suggestion of the well-known paradox about bed being the most dangerous place in the world because so many people die there, must also be borne in mind. But when all the deductions have been made, the single fact still remains, that we are actually safer afloat than ashore, and the risks and dangers of this present war are a striking illustration of the general rule.

On the face of the figures the navy of any of the first-class powers is one of the healthiest places in the world, a regular floating health resort. The death-rate in the British Navy, for instance, from all causes for the ten years before the war had averaged less than four per thousand per year, and in 1913 had actually fallen to 3.24 per thousand, a good average

death-rate on shore being from fourteen to sixteen per thousand, while our own navy is only a fraction of a per cent behind this. Of course, it must be remembered that the Navy is manned entirely by boys and men of from fifteen to forty-five, the vast majority being under thirty, in the very prime of life, the literal Golden Age of health; that they are selected after a careful physical examination and given a thorough try-out during the first six months of their service, to weed out and reject any who are not up to the standard, or cannot be built up to it.

But even allowing for all this, their death-rate and disease-rate afloat is only about half that of men and boys of the same ages on shore. And as the personnel of the Navy represents a thoroughly average sample of the total community ashore, if anything a somewhat larger proportion of its force being drawn from the more poorly paid working classes than would be found in an average town or county, it is fair to conclude that at least three fourths of the boys of all classes on shore could be brought up to the same standards of health if they were caught young and given the same treatment.

Indeed, the Navy is a standing and shining example of what could be done to improve our national health and vigor by giving intelligent attention to the matter. Its splendid results are the more remarkable because they have been achieved under quite unfav-

avorable circumstances, in many respects, and in a very narrow and limited environment. A warship, even of the hugest, is an extremely cramped and limited sort of a place between decks. Its star or parlor boarders are, of course, the engines and their coal. Its second-floor front tenants are the guns and their ammunition, while the men are third-floor back and hall-bedroom boarders, and have to tuck their mess-rooms and sleeping-spaces into whatever corners and gaps are left.

This means that the problems both of ventilating and lighting the sleeping-places of a battleship's company have always been difficult ones. In fact, only in the more modern ships since the introduction of electric lighting and of special fan systems of forced ventilation, have these problems been at all adequately solved. Further than this, the difficulty of obtaining regular supplies of perishable food, such as fresh vegetables, fresh meat, and fresh fish, has always been great, until, in the more recent ships, it has been overcome by the introduction of ice or of refrigerating plants.

Then, too, voyages were long and monotonous, there was nothing approaching society on board, and very little in the way of entertainment or intelligent amusement. The men got stale and restless, and when finally they were given shore leave they were disposed to try and make up for lost time and "take in" the

whole town and its excitements inside of forty-eight hours, with the result that they frequently came back with "a head like a concertina," a beautifully pickled stomach, and a prospect of venereal disease.

It is most interesting to watch how, as these special difficulties have been faced and conquered one after another, the death-rate of the Navy has steadily gone down year after year from about fifteen per thousand, fifty years ago, to eight, thirty years since, and finally down to the present three. There has been no magic about the process, simply good, common-sense, hygienic methods. First of all, improving the food and making it not merely sound and nutritious, but interesting and attractive to the men, especially by means of fresh vegetables, fruits, and sugars. This not only greatly improved the health and comfort of the men and kept them better satisfied with the monotony of their life afloat, but it also greatly diminished their tendency to accumulate "a thirst" or craving for one tremendous drunk and spree whenever they reached the first port and got shore leave.

Then the electric light, in place of two or three smoky oil lamps, which could do little more than emphasize the darkness all round the walls, by throwing a flood of illumination into every corner of the mess-rooms has made it possible for the seamen to read and write and sketch or carve or play games with ease and comfort, thus greatly diminishing the

fighting decks, to take to their boats and even to carry off a considerable proportion of the wounded. But the modern armor-plated and high-engined battleship, which is a marvelous instrument of destruction and a literal floating fortress, — as long as she floats, — when she does make up her mind to go down, founders with appalling suddenness. One single fifteen-inch shell may sink her almost as suddenly as a rifle bullet would a floating bottle. And as her entire ship's company is under cover, many of them in the engine-room and at the munition hoists or in the sick-bay, three or four stories under water, their chances for escape are pitifully small.

Kipling has voiced the deep-seated reluctance of the old-fashioned sailor-man against "going to sea in the works of an eight-day clock," and in one sense the old salt's objection is thoroughly justified. On my visit to the English Fleet, for instance, I met a young captain, a handsome, clear-eyed, almost boyish-looking young officer, who was *the sole survivor of an entire ship's crew and company of thirteen hundred men*. It was in the Battle of Jutland, and he had pluckily climbed up under a hail of fire into the highest fighting top, with his glasses, in order to get a clearer view of the enemy's ships through the North Sea smother and spray. A single half-ton shell struck her at the water line and exploded in her engine-room, and she went down within a hundred seconds. As

she went down, she heeled over suddenly to port, and he was flung out of the fighting top as from a catapult, and landed in the sea a hundred and fifty feet away from her side and clear of her vortex. By great good luck he was unhurt by the fall, and when he came up to the surface found himself within a hundred yards of a destroyer, swam to her side, and was taken on board. And as the Germans were following their usual tactics of firing upon the wounded in the water and upon any boats that put out to their rescue, he was the only one who lived to tell the tale.

An additional horror has been added to this grim risk of modern naval battle by the fact that the Germans have burned up all the moral codes and fundamental decencies, and not only fire upon all boats put out to rescue the wounded, but send up their submarines to torpedo the ship which checks her headway for this purpose. Two thirds of the first English and French vessels which the Huns succeeded in sinking were caught in this dastardly way, and the Admiralty was compelled to issue an order forbidding the lowering of boats for the rescue of the wounded, on account of the serious risk to the much larger numbers on board the ship.

In some instances the Huns actually fired upon the English boats which were putting out to rescue German wounded struggling in the water. If they could get two English lives by the sacrifice of one of their

own, the transaction showed a clear profit, in their code of morals.

Another somewhat unexpected result of the tremendous piercing and explosive power of the big shells, combined with this new sea-wolf code, has been the complete reversal of the usual proportions which obtain between killed and wounded in land battles. The one ratio in the present war which has not changed is that between killed and wounded, which has remained curiously constant at between four and five to one for the last two hundred years; that is to say, out of every hundred casualties twenty will be deaths, twenty rather serious wounds, and the remainder, light wounds. In a few battles in the earlier months of the war, before methods of protection against modern artillery had been properly developed, the proportion of killed outright ran somewhat higher, in some instances up to thirty and even fifty per cent of the total casualties, but of late the tendency has been strongly in the other direction, and in the engagements of the past summer, in the British Army, for instance, the proportion fell as low as only one death in six and even one in ten casualties.

The situation in the Navy is almost exactly the reverse of this, and in its only two or three really important engagements of the war, while, of course, it is not permitted to publish the exact figures, the number of wounded was barely one tenth that of the

dead. A "Jacky's" risk, therefore, is almost literally "neck or nothing." He either escapes scot-free or goes to the bottom, nine times out of ten.

This grimly simplifies the problem of caring for the wounded and makes hospital ships far less necessary than was anticipated, as each battleship that remains afloat after an action is pretty nearly able to take care of her own wounded until she can carry them into port herself, or transfer them to a light armored cruiser, which will act as collecting ambulance for the entire fleet.

Each battleship has a well-appointed and equipped sick-bay or small hospital ward, with from ten to fifty beds, according to her rating and the size of her company. There is an operating-room, an X-ray equipment, steam sterilizers, and everything which is needed to take care of all but the most complicated cases of surgery. Everything is spotlessly clean, and there is a highly competent staff of surgeons and assistants and hospital attendants on board each of the larger ships, but the quarters are necessarily cramped and fearfully noisy for men whose pain keeps them awake.

Moreover, even the biggest dreadnoughts and cruisers, though they ride the waves nobly, are not exactly transatlantic ferries, especially in rough weather, while the destroyers are just about as easy to ride as bucking broncos and little better than

jumping hells for men with deep wounds or broken bones. Their hearts are literally too big for their bodies, and the whizzing speed at which they are driven by their tremendously powerful engines gives them no time to ride over the waves, but sends them slap through them, like flying thunderbolts, or even scooting from one wave crest to another like a skipping stone playing ducks and drakes. It is a never-ending marvel how they manage to keep afloat at all in rough weather; they come heaving up out of the sea smother like a huge flying dragon swattering along the surface of the water; by the time you have made out what they are, they are abreast of or on top of you, and you duck to let them go over your head, and before you can catch your breath and turn round, they are hull down and out of sight on the horizon behind you, leaving nothing but a trail of smudgy smoke and a whining roar like a big shell, to prove that they have ever been there! They are like flying expresses tearing along the surface of the sea, and you would n't be surprised at any moment to see them rise right up into the air like a big airplane — all that seems necessary would be a feather duster on each side of them. In rough weather their crews have to be strapped into their bunks at night to keep from being hurled out on to the floor, and for wounded men they are simply impossible.

The proposed plan and normal method of handling

the wounded in the Navy was for each fleet to be accompanied by its hospital ship or ships following at a safe distance behind it and steaming rapidly up after an action to take on board the wounded from the different ships. But this plan has been seriously interfered with by the new conditions. First, because the hospital ships are not fast enough to keep up with the battle fleet, which has to steam like — in order to try and catch up with the Germans before they can get back to port. Second, because, in order to transfer wounded, a battleship is obliged to heave to, and this exposes her to torpedo attacks by submarines. Third, the transfer of wounded from huge floating fortresses like modern battleships is only possible in the calmest of weather, and this practically never happens in the North Sea. It furnishes a wide variety of weathers, but each is usually rather worse than the one before it. Whenever it does n't blow, there is fog, and whenever there is n't fog, it is blowing at least half a gale.

In order to meet this situation, it has been suggested that small, swift vessels of about five or six hundred tons, registered and protected according to the Geneva Convention, should be specially equipped to pick up rapidly survivors from the sea or to hang alongside moving battleships and catch the wounded as they are slung overboard.

But even these would still be subject to the last

and greatest difficulty of all, and that is, the habit of the Hun submarine sea-snakes, of torpedoing and sinking every hospital ship that they can reach on one lying pretext or another.

But in actual practice so far no serious difficulty has arisen, partly because the German warships, most judiciously, have kept so close in the shelter of their own ports, where most of them are reported to be roofed over with a sort of floating boat-house, which keeps out drafts and the damp air and prevents deterioration of their equipment and crew. Partly because they make such excellent time back to their kennels whenever they do prowl cautiously out and happen to run into something, that there has been little difficulty in every battleship which has been lucky enough to catch sight of a German getting back to where it is safe to transfer the wounded to a hospital ship, or even to land them at one of the home ports.

These hospital ships are beautifully equipped with every modern medical and surgical appliance, with a full surgical staff and splendid corps of women nurses supplied by Queen Alexandra's Royal Naval Nursing Service. They are literally floating hospitals in the best sense of the term, with cots for from two hundred to three hundred cases, divided into wards on the different decks, and with perfect lighting and ventilation everywhere. The wounded I saw on the



STRETCHER DRILL: TAKING AN "INJURED" MAN BELOW FOR TREATMENT

two which I visited were literally in clover and as comfortable and well cared for as if in a modern city hospital on shore. But as the Navy surgeons who accompanied me pointed out, for the reasons already mentioned the hospital ships were practically compelled to remain at anchor most of the time, and it was only a matter of a few miles farther steaming to discharge the wounded men at the landing-stage, where the ambulances were waiting to carry them up to the hospitals on shore. And as the sum paid for the charter of these commodious and beautiful hospital ships was in the neighborhood of a thousand dollars a day, a good hospital completely equipped, convenient to the landing-stage, with the same capacity as the ship, could be built for about the cost of six months of her charter. So that it looks as if in future wars the naval hospital ship will probably be replaced by much smaller, swift vessels acting as marine ambulances and picking up the wounded, either from the water or from the battleships, and making a flying trip back with them to the nearest port where there is a hospital train or a port hospital.

Another somewhat unexpected thing about the wounded in the sea-fighting of this war was, that although the shell splinters with which they were struck had had no opportunity to bury themselves in the ground before exploding and so come up loaded with all the germs and filth of manure and fertilizer,

nevertheless, almost every one of them was infected, although, of course, not nearly so heavily and virulently as those of the land battles.

Part of this might be accounted for by the fact that some of the wounds were made by splinters from the deck or sides or furniture and equipment of the ships themselves, which, of course, even with the most perpetual scrubbing and spotless cleanliness, could hardly be kept aseptic, what with grease and grime, coal dust, and human traffic. But it also supports the impression, which is quite general among Army surgeons, that the fragments and filling of modern explosive projectiles are by no means aseptic, even when they burst in the air and have no opportunity to touch the ground at all before exploding.

I made careful inquiries at a number of the big munition works which I visited, as to the nature and handling of the "filler" which is put into the shrapnel shells to pack the bullets into a solid mass, and found that it was composed largely of a gelatine-like substance, which was liquefied by heating and then poured in to fill up the little spaces between the bullets, much as syrup is poured into a jar of raspberries or strawberries in canning. And as gelatine is made out of the hoofs and bones of horses and cattle, without any attempt to render these sterile, except for the finer grades which are to be used for food purposes, and as the heat applied in melting was not at all suffi-

cient to destroy any germs which it might contain, it is possible that this might have been our source of the practically universal infection of all war wounds from explosive projectiles. Some of the larger shells were filled up with irregular cubical fragments of scrap iron shoveled right up from the earthen floor of the furnaces and foundries, and this, of course, might easily mean another source of infection.

Several of the military eye surgeons, both Navy and Army, expressed their surprise that so many wounds of the eyes with which they had to deal were infected and suppurated, in spite of everything that could be done. And this, too, in a number of cases where the eyes had been wounded by fragments of shrapnel which were known to have burst in the air.

The most singular splinter driven into an eye by the explosion of a shell was one reported to me by one of my Navy surgeon friends in the Home Fleet. The eye was so hopelessly torn and lacerated that it had to be removed, and on cutting it open to find the splinter which had destroyed it, my friend was astonished to discover, deeply embedded in the eyeball, a *fragment of bone from a human skull*. It was nearly three quarters of an inch square, large enough to be perfectly recognizable as a portion of the vault of the skull, and on inquiry it was found that the wounded man's mate at the gun had had his head blown to pieces by the same shell!

Even for all the difficulties which Hun brutality has created in the way of caring for the wounded, the same splendid results were obtained as in the Casualty Clearing-Stations and Base Hospitals on dry land; that is to say, a recovery rate of between ninety and ninety-five per cent and a hospital sojourn of an average of less than three weeks before the wounded were discharged as recovered, eighty per cent of them to return to active service.

Nothing could be more thorough and admirable than the system which has been planned and installed for the care of the wounded from the fleet when they are once landed. Hospitals were built both in the towns nearest to the several rendezvous of the great fleets, and beds were provided in almost every town of any size on or near the eastern coast of England, this being the only one which German warships other than submarines had any possible chance of reaching. Then ambulance units were organized in or near practically every tiniest harbor or even fishing village which possessed a landing-stage or pier and where there was a possibility of wounded men being landed after an action. These were connected by telephone and motor with the nearest city hospital, so that any ship's launch, with a cargo of wounded, could strike the English coast at any point at random and upon wireless or rocket signal find an ambulance and crew at the pier or beach to meet them and transport

them to a hospital bed within thirty or forty minutes at the outside.

Then, to link this long line of ambulances and hospital stations, four hospital trains were constructed, which made regular backward and forward trips on an average every three days from the northernmost group of hospitals and landing-stages right down to the great Base Naval Hospitals in the South, such as those at Chatham, Portsmouth, Plymouth, etc. I had the pleasure of making the trip with a company of sick and wounded on one of these ambulance trains from the far North right down to the southwestern coast of England. The train was made up of twelve coaches and had cots for a hundred and twenty and sitting space for fifty lightly wounded. They had a staff of two surgeons, thirty-six stewards and sick berth attendants, and were arranged corridor fashion, so that the surgeons and attendants could readily pass from one end of the train to another at any moment. They had, of course, a kitchen and full cook staff and served excellent meals *en route*, and had a well-equipped dressing-room, dispensary, and even a small operating-room, where emergency cases could be dealt with. Stops were made at each of the principal towns, where sick or wounded who had recovered sufficiently to travel and wanted to go south were taken on, or where wounded men from the northern bases were dis-

charged because their families lived in that neighborhood, and so would be able to visit them during their convalescence in the local hospital. It would have been hard to imagine anything more efficient and more comfortable, and it left in one's mind a feeling of absolute certainty that the surgeons of the British Navy would be able to deal promptly and effectively with even the largest possible rush of wounded from the greatest of naval engagements in record time and magnificent style.

As for the general health of the Navy, both the British and our own can show the same splendid record that our armies can, namely, an actual reduction of its already low level in time of peace, and far below that of the civilian population of the same ages on shore. The only diseases which have caused any trouble in this war have been measles, diphtheria, and cerebro-spinal meningitis among the recruits and boys from the Naval Reserve chiefly in the training schools on shore, just as occurred with the Army recruits in their training-camps. The same curious increased susceptibility to the milder diseases of childhood, such as measles and scarlet fever, as was shown in the Army by the Australians, the New Zealanders, and the recruits from Shetland and the Orkney Islands, has also shown itself in the Navy among the boys from the same Northern islands. Some of the surgeons were sufficiently interested to trace back the

cases and communicate with the local physicians in the Northern islands, and found that in most of them measles, for instance, would only occur once in six or seven years, when infection happened to be brought in by children from the mainland. So that many of the Shetland and Orkney boys and girls grew up without ever having been exposed to the infection, and the community as a whole had developed no distinct resistance to the disease.

There has also been some slight increase in the other common infections, due to the fact that a flood of new recruits has poured into the Navy raising its war strength to nearly three times the numbers of its peace footing. But the new recruits have for the most part been vigorous, sturdy men and boys, a large number of them fishermen or coastwise sailors and merchantmen, who were brought into the mine-sweeping and patrolling divisions, and the excellent food and care which they have received has quickly brought them up into first-class condition, as soon as they have "sweated out" the few scattering infections which they brought with them from shore, so that the total sickness-rate of the whole force has not been appreciably increased.

Rather unexpectedly, in view of the striking purity and healthfulness of sea air and the fact that sea voyages have long been recommended for the cure of pulmonary disease, there has been a slightly larger

number of invalidings for tuberculosis than might have been desired. But this is barely half the rate of this disease among men of the same ages on shore, and is due to the inevitable and perplexing problem of providing adequate ventilation and sufficiently frequent change of air for a thousand men, where there is theoretical or ideal cubic space for only three hundred. And with the infinite pains and skill taken in equipping the newer ships with elaborate systems of forced ventilation by means of fans, even this age-old problem is well on the way toward solution. The introduction of oil-burning engines and of turbines is also helping to solve the problem, because this makes nearly two thirds of the space taken by coal bunkers and engine-rooms available for sleeping-quarters and mess-rooms and reading-rooms for the men.

The largest number of cases under one heading falls naturally to the credit of that special pest of the soldier and the sailor, venereal disease. But this, so far from increasing during the war, has shown a marked and gratifying diminution, due to the new and intelligent methods of dealing with it. In fact it was the Navy that was the first to set the example, which has been followed by the Army with admirable results. Frank and friendly talks were given to the seamen by the Fleet surgeons, covering every aspect of the subject, the dangerous after-effects of the disease and its menace to their future wives and

children. Then they were given protective remedies against it, and were told that if, on their return to the ship, they promptly reported to the hospital orderlies if they had been exposed to infection, they would be put under treatment at once and neither punished nor docked of their pay even if the infection should develop.

Theoretically, this method is open to the single objection that it teaches the men how they may run risks with comparative impunity. But, practically, this possible lessening of the fear of infection has been heavily overbalanced by the increase of the men's intelligence and knowledge of the disease and the appeal to their patriotism and their respect for their wives and future children. In the paradoxical language of a famous cynic, "Nothing survives being thought of," not even the running of venereal risks. At all events, the figures have fallen to barely half of the peace-time prevalence of the diseases, that is to say, about five in a thousand. What this means may be gathered from the instance of one large battleship, which on touching at a certain port gave eleven hundred of its men shore leave, with the result that only three cases of venereal disease followed!

By a curious paradox the next prominent disease in the Navy in time of war is neurasthenia and mental depression. What a set of bluff and jolly "Jack Tars," in their home on the ocean wave in piping

times of war, should be doing with a parlor disease like this is at first sight a puzzle. But it is explained by the fact that after the first few months, when there were still a few German war vessels and cruisers afloat to provide a moderate amount of excitement, the task of the Navy has been one of constant and sleepless strain and watchfulness in all sorts of weathers — except good — with the most tremendous interests and responsibilities hanging upon any slackening of vigilance, and with nothing whatever happening to break the monotony. They have cruised backward and forward, backward and forward, in fog and rain and spindrift, and snow and storm and sleet, day after day, month after month, for four mortal years, and except for the Battle of Jutland, the clash off Heligoland, and an occasional brush between destroyer patrols, with nothing whatever to show for it. This is admirable prudence on the part of the enemy, but bitterly disappointing to our sailor-boys. To sweep the sea for four long years with the finest fleets ever assembled under one group of flags and be unable to get a fight out of anybody is enough to drive any set of sailors to mental depression or to drink.

Of course, they know, and the world well knows, that they have swept the seas of the world clear of every craft that dares fly the enemy's flag above the surface, that they have drawn a noose around the

neck of the German Brute and are slowly but surely strangling him to death, that but for their superb, devoted and almost thankless service the war would have been ended in six months, that they have transported and convoyed across the seas millions of troops, their equipment and four years' supplies, with the loss of less than a thousand soldiers, and have kept all the highways of the seas the world over safe for the commerce of civilization and freedom. But this is poor personal consolation to half a million fighting Jack Tars, all of them just praying for a "scrap," and it is little wonder that they get melancholy and despondent in their minds about it. The only nerve tonic that would cure their depression is for the German polecat to come out of his hole and give them a chance to even up scores and express their opinion of him in the only language he can understand.

XX

SHELL-SHOCK AND THE MENTAL STRAIN OF WAR

THE first thing that was predicted of this war was that human nerves, especially civilized nerves, could never stand the strain. That our sensitive neurasthenic nervous system, keyed up and pampered by the abnormal conditions of city life, would break down under the shock of its horrors. Not only would our soldiers become nervous wrecks, but the ruin of their mental balance would be so utter and foundation-shaking that generations yet unborn would pay the penalty in an inheritance of terror and morbid fear! Forgetting, as any biologist could have told us, that the nervous system is by a strange paradox, both the most sensitive and the toughest part of the animal! Here the war has been going full boiler-shop hammer and tongs for three years, and our insane asylums, instead of being crammed to overflowing with the mental wrecks of the war, are actually getting emptier every year, and the thousands of babies born of war marriages are as fat and sturdy and crowing and normal in every way as ever clutched at sunbeams or tried to get their pink toes into their mouths.

What has been the net result of three years of continuous war upon the nerves of the soldiers? Astonishingly little, on the whole. Indeed, far the heaviest nerve-strain of this war has fallen upon the anxiously waiting or bitterly weeping wives and mothers and sisters at home. Yet column after column and headline upon headline have been devoted to "shell-shock."

As soon as you come to look into the facts of the situation you find, first, that the term "shell-shock" has been and is yet extremely loosely used, and second, that it has attracted ten times the attention that its importance really deserves.

"Shell-shock," in fact, has been applied as a convenient term for *any form of disability in a soldier not accompanied by a visible wound*, or other clear physical injury. It has been a diagnostic dump on which have been shot all sorts of disturbances which had no clear and obvious cause, and has proved as blessed a convenience for pathologic haziness as "neurasthenia," "uric acid," or "general debility." It satisfies both doctor and patient and means nothing in particular.

As soon as the litter is emptied out of the shell-shock waste-paper basket and attempt is made to sort it, most of it falls roughly into two quite distinct and different groups.

One, in which the patient, or his comrades, give a

clear history of his having been knocked down, or hurled some distance, or blown up into the air, or not infrequently buried by the blast of a high-explosive shell. He is picked up unconscious and awakens in a dazed, half-delirious state. Or else he is found wandering about in a sort of walking delirium, quite out of his head, having forgotten, not only what caused his condition, but also the number of his regiment, its bivouac, and even his name.

After a few days' rest and care, his delirium subsides, his memory comes back, he complains of intense fatigue, weakness, and general muscular soreness, due probably to the physical shock and violence inflicted by explosion; but this steadily improves, and unless internal damage has been done most of this class of cases get well.

A few, however, unfortunately, remain permanently weakened both physically and mentally, although their minds clear and memory comes back, and still fewer break down rapidly and ultimately die. *Post-mortems* held upon some of these show innumerable small hemorrhages scattered all through the substance of the brain, due to the rupture of tiny blood-vessels by the terrific shock, even though the skull itself was not fractured. This greatly helps to explain the symptoms of this class of cases, for probably many who remain permanently weakened both muscularly and nervously have had their brain sub-

stance actually damaged in this way, though not severely enough to cause either paralysis or death.

Shell-shocks of the second group, though at first sight somewhat similar, are really quite different in character. They resemble those of the first group in that they usually occur after a battle and the patient is found wandering about in a dazed or demented condition.

But here the likeness ends, for when the victim rambles or is brought into a Field Hospital, he often gives a most dramatic and harrowing story of having been hurled yards up into the air by a tremendous explosion, or buried for hours in a dug-out or shell-crater, or seeing his comrades blown to pieces before his eyes, and perhaps spattered with their blood and brains! Quite different from the halting speech and hazy memories of the real shell-shocks. On investigation his moving story is usually found to be only partially true, and often totally unfounded — a pure hallucination in fact. He may prove not to have been in the front trenches at all, or to have come from a part of the line not under fire!

Then he quickly begins to develop a whole crop of curious symptoms, such as no physical injury could possibly produce. He becomes suddenly totally blind, or deaf, or dumb, with no sign of actual brain or nerve damage, and as might have been expected after weeks or months completely recovers his sight,

or hearing, or speech, as suddenly as he lost it. One or both of his hands close firmly and can hardly be pried open, or his legs suddenly draw up in bed and he can't possibly straighten them.

Commonest of all is a curious twitching of certain groups or of most of his muscles, so that he cannot hold his head still, or walk or stand, except with incessant jerkings and tremblings, and if he attempts to speak he stutters and stammers in the most appalling way. All these jerkings and twitchings are increased by excitement. You are brought into a shell-shock ward and stop to look at one of the patients. Instantly he begins to stammer and jerk, then the man across the aisle follows suit, and the contagion spreads in widening circles until the whole ward is set jerking and twitching. All the movements and most of the spasmodic contractions cease during sleep.

In fine there is a strong element of what for want of a better word we term "hysteria" in this class of symptoms. But let it be clearly understood that whatever hysteria may be found to mean, it *does not mean shamming or deliberate pretense!* The poor fellows are far too miserable and really ill for that.

In fact, this second class of shell-shocks clearly represent men of defective nervous systems or ill-balanced minds who have been thrown off their balance by the strains and stresses of war. Some of them might have been able to "carry on" and "get

by" indefinitely in the milder times of peace, but the conviction is steadily deepening among mental experts that the breakdown of most of them has only been *hastened* by the shock of war. In other words, they represent little more than the normal average insanity rate among men of military ages.

One of the most striking features of this war has been the tremendous and incessant character of the roar and thunder of battle. The world has stood aghast at the astounding development of ordnance, the unexpected and well-nigh incredible increase in the size, range, and number of heavy guns, the undreamed-of expenditure of ammunition, and the way in which the war has become one of heavy artillery, the infantry in many cases only going forward to pick up the pieces after the big guns have done their work. Indeed, preparing the ground for infantry is technically known as "cultivating the soil."

An army which for nearly twenty years was considered well equipped for battle with a few score heavy cannon now calls for thousands. More ammunition is expended in two days' offensive on the Somme than was spent in the whole of the Boer War. Add to this that the range of the average heavy gun is now about seven miles, and that the really big ones can carry up to sixteen and eighteen, so that the soldier never knows when he is safe; that all projec-

tiles are explosive, many of them being as tall as a man and weighing fifteen hundred pounds, and that the crash which they make when they land is like the blowing-up of a mine or the explosion of a powder factory — and you can form some faint picture of the nerve-racking bellow and thunder and roar of shell-burst in which the modern soldier has to live and fight. The marvel at first sight (and hearing) is that even the most iron nerves should be able to stand the strain or the best-balanced reason escape shipwreck, or at least grave disturbance.

Another factor in “frazzling” a susceptible nervous system, which is not perhaps quite fully appreciated, is the tension produced by the incessant strain of day and night watchfulness against shell-fire. In former wars a soldier in the open field “went under fire” for a few tense, thrilling hours of battle, and then he either drove back the enemy or withdrew out of the range of his guns. Now he is literally under fire every minute of the time, from the moment that he detrains at the rail-head to the day that he is lifted into the Hospital train for Blighty or his regiment is withdrawn for reinforcements and repairs.

Offensives come and go at intervals it may be of months, night raids into the enemy’s trenches occur weekly, perhaps, in limited areas, but the duel of the artillery never ceases. From the time you arrive within twenty miles of the trenches you can hear it

booming and thudding and thundering, day and night, like the roar of a heavy surf on a rocky coast.

Moreover, on account of the tremendous reach of modern artillery, most of the reserve, or rest camps, both in huts and in villages, to which the troops are brought back between turns of trench duty, are within possible range of the enemy's guns, and he takes excellent care to remind them of that fact at frequent intervals. Hence, in quiet parts of the line, between active offensives, it not infrequently happens that more men are actually killed by shell-fire, "in their beds," so to speak, in the reserve camps, than are hit in the first-line trenches.

In addition to this, the Germans always have a few extra heavy naval or other long-range guns with which they keep constantly "reaching out" ten, twelve, and even fifteen miles for everything their airmen can see which shelters, or looks as if it might shelter, any living human creature, whether they be camps or villages, forts or churches, hospitals or rail-heads. The motto of the Hun at war is, "Kill everything you can reach, it may help the cause somehow"; and he makes war, not against an army, but a whole nation.

On the other hand, there are certain redeeming features of this incessant turmoil and uproar which lessen its racking effect upon the nerves. The soldier is never, so to speak, at both ends of the flight of a

shell. From the very fact of the tremendous range of the guns, if he is in the front-line trenches, for instance, he practically does not hear the enemy's guns which are firing at him, at all, or only as a confused, distant roar and rumble.

On the other hand, his own artillery is some miles behind him, so that all he hears of his own guns is a moderate boom and roar, with the clear whistle of their shells over his head, which on the whole is consoling, rather than otherwise, and helps to steady his nerves by assuring him that he is being well supported and protected. So all that his ear-drums have to stand is the explosion of the enemy's shells as they arrive, and these, though bad enough, do not make half the fierce concussion and nerve-racking noise of the firing of the guns themselves. Besides, so many of the shells pass over his head or fall short, or land some distance up or down the line from him, that the constancy of their arrival in close or dangerous proximity is not nearly so great as it might be supposed from the enormous number incessantly hurled in his direction.

Just as a matter of nerve-straining and head-splitting noise, and an intolerable row and racket, the "hottest" place a soldier can get into, is in reserve, just in front of, or just behind, his own guns. I have been caught there several times myself, and can speak feelingly. It seems as if the very breath were going

to be blown out of your body and your head split or your hair torn off by the vicious blast and whizz of the shells, just two inches above the top of your cap, and you think the end of the world is about to come. But after twenty or thirty minutes of gasping and reeling, you gradually adjust yourself, realize that it is not going to kill you after all, or even do you any serious damage, and, by and by, you derive a little mild consolation from the thought of what this tremendous roaring and belching must be doing to the enemy at the other end of the range.

In fact, it is quite within the powers of the human nervous system to call up its reserves and adjust itself even to the murderous and appalling crash and thunder and shriek of modern artillery bombardment. Gradually it dawns upon the young recruit that not one thousandth part of the horrid and astounding racket and roar and crash that he hears means anything to him personally, not one in fifty of the shells that he sees or even hears explode puts his individual life in any danger.

He learns to distinguish instantly and almost unconsciously without even thinking about it, between the clear, cheery, diminishing whistle of his own departing shell, and the hoarse, menacing, crescendo, raucous scream of the arriving enemy shell. Indeed, incredible as it may seem, the big noise soon comes to mean little or nothing to him at all, as no gun that

he can hear is going to touch him and every shell that he hears explode has missed him; for if it landed close enough to strike him the fragments would arrive before the sound did. The Sinaitical thunder and mighty roaring wind of the big guns and the bursting shells leave him unmoved. The only thing that tries his soul and vexes his nerve is the still, small voice of the angry whine of the approaching shell, rising swiftly shriller, more threatening, and more personal every instant, till it suddenly changes to a delightful and soul-relieving diminuendo over your head and beyond, or ends in a dull thud and roar "out of bounds," or "off the map," so far as you are concerned. For the moment you have the most utter, disgracefully immoral and anti-social indifference as to whom or what it may have landed on or hit, so long as it has missed you. Even selfishness has its uses and fatalism is a positive life-saver when applied to nerve-strain from war dangers.

As the charm of newness and the glamour of dramatic appeal are falling away from shell-shock, much of its mystery is clearing up. It is coming to be recognized as chiefly the revelation of the measure of nervous unfitness and mental unbalance admitted into our Army. In other words, the number of men enlisted who *never ought to have been accepted at all!*

This, of course, does not apply to what might be

described as the "blown-up-and-knocked-down" group, who are perfectly normal men, temporarily dazed and disabled by a terrific blow on the head. These usually recover fairly promptly, except an unfortunate minority who have suffered actual brain hemorrhages or other internal injuries.

But the great body of lasting or permanent shell-shocks, who linger on for months and even years to try the souls and defy the healing skill of both Army doctors and specialists at Base Hospitals, and who fill three fourths of the beds in the wards and hospitals specially set apart for shell-shock, are of a totally different type. In the first place, most of them are almost as defective physically as they are mentally — undersized, under-weight, narrow-chested, shuffle-gaited, slack-jawed, with badly shaped heads, irregular features, and vacant or restless expressions. Take fifty or more of them together and the impression of what the mental experts term "constitutional inferiority" is unmistakable. This is confirmed by hundreds of actual measurements, height, weight, chest-girth, muscular power, taken in the larger special hospitals for their care.

In the second place, careful tracing of the previous history, both of the patient and his family, carried out in over two thousand cases by such eminent authorities as Dr. F. W. Mott, of the Maudsley Hospital, London, show clear proof of previous attacks of

mental disturbance and nervous instability in either the shell-shock himself or his near relatives and ancestors in two thirds of all cases.

Furthermore, these lasting cases of shell-shock show a marked "up-and-down" or "circular" character, just like ordinary insanity, a tendency to periods of improvement, even reaching apparent recovery, quickly followed by relapse, usually to a little lower level than before. Not a few of the patients at the Maudsley Hospital were there for the second and even the third time, having recovered and been sent to the Front in between. One poor fellow, who was pluckily anxious to return, lasted just three weeks after he again reached the trenches, and another only three days! Which makes rather expensive soldiers!

In fine, a large share of shell-shock is merely ordinary insanity occurring in war-time and having its delusions colored by the fears of the battle-field and given a military stamp. Several common forms of insanity begin with what are called "delusions of persecution." The patient is firmly convinced, obsessed in fact by the idea, that certain persons or agencies, usually unknown and referred to as "they," or "the same lot," are "after him," either with the intention of doing him bodily injury or that they are spreading all sorts of malicious lies and false reports about him among his friends or his fellows or with his employers.

If he happens to begin to break down in the camp or at the Front, these impersonal, unknown enemies naturally become Germans or German spies, or even individual German guns, which he will assure you with tears in his eyes are specially shooting at him, following him about to different places, and have only just missed him several times and next time will surely "get him."

One poor boy whom I saw kept coming back to camp and reporting most detailed and circumstantial hair-breadth escapes of this sort from enemy shells, when no one else had seen or heard any shells fall in his particular part of the field. His surgeon, finding him a nervous wreck, sent him back to the Base, and there his hallucinations promptly changed to the pitiful idea that he had shown the white feather and that "voices" were going about informing everybody of that fact, so that people stared and pointed at him on the street. This so preyed on his mind that he finally made a desperate attempt to commit suicide and broke down into unmistakable insanity. He had made an excellent record for both bravery and devotion to duty before the inborn defect in his brain began to manifest itself. I say inborn, because later inquiries revealed the fact that his father had committed suicide while insane.

Another English soldier who, after several temporary attacks of shell-shock, had at last become

clearly demented, was being sent away to an asylum from one of the war-hospitals I was visiting. The specialist in charge was looking him over for the last time and signing up his papers, and, as required by law, asked him the question, "Have you any complaints to make of your treatment here?" "No," said the patient; "no, but I do wish you had taken this wireless receiving station out of my stomach. The Huns keep sending me the nastiest, most disagreeable, and insulting messages through it and I can't stop 'em!" "Well," said the doctor with a smile at me, "why don't you get a pair of clippers and cut the wires?" "Ah, I can't do that you know, it's *wireless*!" Even the hallucinations of the insane have to be strictly scientific and up to date nowadays.

Another young soldier, scarcely more than a boy, whom I saw in one of the Base Hospitals in France for shell-shock, had settled upon bombs as his particular enemy and *bête noir*. He had walked into the Field Hospital after a battle, in a sort of somnambulistic state, and immediately upon being put to bed fell into a deep sleep from which it seemed impossible to awake him. If liquids were placed in his mouth he would swallow them; so he was fed through a spouted cup for several days, when it was found that, although he would pay no attention to the loudest of shouting or vigorous shakings, if food was placed close to his nose so that he could smell it, he would

reach out for the plate and proceed to feed himself with his fingers, still keeping his eyes firmly closed.

All sorts of means short of unjustifiable violence were adopted to try and bring him out of his hysterical sleep or self-hypnosis, including shouting various alarms into his ear, but without the slightest effect until it was discovered one day that there was just one word to which he would react and fairly promptly, and that word was "Bombs." To this word he would respond at once and in a most curious and definite manner. The doctor, after giving us his history, but without telling us what to expect, shook the sleeper, shouted his name in his ear loudly and flashed a big electric torch in his face two or three times without the slightest response. Then he called out, in much lower tones than he had used before, "The bombs, where are the bombs?" at the same time throwing an old briar-wood pipe under the bed.

Instantly the sleeper stirred, lifted himself slowly from the pillow, rolled out of bed onto the floor, and dived under his cot. There he groped about, still with his eyes firmly shut, until he found the pipe, threw it out of the window, and crawled back into bed again. I say "out of the window," but in reality it struck against a screen with which the window had been covered, because at the first trial, before it was known what he would do with the "bomb," he had

been allowed to pick up a good-sized electric torch and hurl it through the glass.

Evidently he had become vividly in dread of the possibility of bombs being thrown into the bay of the trench which he occupied, but he had n't even a bruise or a scratch on him anywhere, and no history could be obtained of his having had any particularly narrow or hair-breadth escapes from the explosion of a bomb or seeing any of his comrades blown to pieces by one.

Now come the important practical questions, What is to be done for shell-shock? and, What is the prospect for recovery? Obviously neither of these questions can be answered in a sentence, for there are almost as many different kinds of shell-shock as there are of shocked soldiers; while as for treatment, some will recover without anything but a judicious "letting alone," others will get steadily worse in spite of every known and imaginable treatment. However, certain broad general lines can perhaps safely be laid down, always vividly remembering that few diseases follow rigid rules, and that shell-shock seems to consist chiefly of exceptions.

In the first place, while recovery is always slow, the prospects for regaining a moderate amount of comfort and efficiency are fairly good in the great majority of cases. Naturally, there is a wide difference between the two different classes of shell-shock

patients. Those of the first class, normal, vigorous men who have suffered definite physical violence from explosion or burying, although it may not have actually broken a bone or visibly marked the surface of their bodies, have in the nature of the case much the best chance of recovery. In fact, it may confidently be expected that two thirds to three fourths of them will get well, all, in fact, except those who have suffered hemorrhages or other internal injuries to the brain or spinal cord.

It must, however, be remembered that there are a good many border-line cases in which the shell-burst that actually knocked them down or stunned them was only the last finishing touch of a series of war-strains both physical and mental, which had been for some time breaking down their nervous resistance. These, of course, will recover very slowly, and will often have great difficulty in reaching a sufficiently complete recovery of balance to allow them to return to their posts and to continue to stand up under the same strains which broke them down before. In fact, it may be frankly said, that as a general rule it does not pay to send recovered shell-shocks back to the Front. Especially as there are plenty of positions behind the lines, where they can be of even more military value.

Even in the second class of shell-shocks, those unfortunates in whom the war and its dangers and

strains only slightly hastened the time of their breakdown and determined the character of their delusions, the prospects for recovery are fairly favorable in the majority of cases, though this recovery naturally will seldom be complete and may not be permanent. There is an exaggerated feeling of dread and aversion to the term "insanity," which has seriously hindered the proper acknowledgment and treatment of these cases, because it is believed that the mere use of the term is equivalent to sentence of lifelong incarceration in an asylum.

So far from this being the case, fully one third to one half of all cases of insanity, even of so advanced and clear a type as to be admitted to an asylum in times of peace, recover in the sense of being able again to maintain and take care of themselves in the battle of life. And in the case of these breakdowns in the soldiers, we have the great additional advantage of being able to give them a complete and striking relief from the strains which have proved too much for their balance, and a most radical and restful change of scene merely by withdrawing them from the Front and sending them well back to the Base, or, still more, to England. There careful psychic re-educational treatment with baths, massage, tonics, etc., will often make them most useful soldiers again, though seldom for front-line duty.

While a good many of this class of shell-shock cases

were probably already on the down grade mentally, and it was only a question of time when the final collapse would come, not a few of these war-wrecks would probably have stood the wear and tear of business and civil life for a considerably longer period, or perhaps indefinitely. And this class stand a good chance of recovery by being sent back to civilian life.

On the other hand, it might be said in passing that there is ground for the paradoxical belief, that while war-strains break down a certain number of unsound nervous systems earlier than normal, they appear to stimulate and build up and postpone the breakdown of other cases with poor nervous stability.

The one consoling fact of all this business of shell-shock and war-strain is, that when all is said and done and its seriousness and unmanageableness fully recognized and every known case listed and counted, the sum total of all classes which last more than two months is little more than the average "normal" percentage of insanity among men of military age in times of peace: that is to say, about two per thousand of the total forces on the Western Front.

A similar process seems to be taking place among the civilian population at home, for while in the beginning of the war there was a slight temporary increase in the number of admittances in the hospitals for the insane in England, this was completely balanced by the end of the first year, and for the past

two years there has actually been a falling-off of over two thousand cases per annum in the number of commitments to asylums.

In the autumn of 1917, for instance, I found that the total number of all cases of shell-shock in the military hospitals in England was 2760. And this represented the accumulations of three years of war — less those passed on to insane-asylums — from an army of at least five million men.

Shell-shock is one of the rarer and least important of the wrecks of war.

A similar process in less degree took place in France. What apparently happened was, that the first terrific shock and upheaval of the war upset promptly all those who were near the point of a mental breakdown. But later the new interests and responsibilities, the new enthusiasm of patriotism and devotion to the common welfare created by the war, lifted the nervously depressed out of themselves and enabled them to get a new grip upon life and sanity. This was probably also felt in the working classes because of the abundant employment, for even unskilled individuals of all grades of capacity had high wages, which both gave them a more cheerful outlook on life and enabled them to feed themselves and house themselves much better.

In other words, civilized man evidently still possesses wide powers of adjustment and has succeeded

in meeting and accommodating himself to even the terrible strains and griefs and hardships of this colossal war in the most surprising and gratifying manner. This is particularly noticeable among the men out at the actual Front. From Ypres to the Isonzo, from the Somme to Verdun, wherever one strikes it, one is instantly impressed with the fact that the Front is far and away the most cheerful region to be found anywhere in this war. Instead of being depressed by their hardships and dangers, the actual fighting men, whether Tommies, Anzacs, Poilus, Alpini, Yanks, or Bersaglieri, seem to be exhilarated by them. Life may be short and uncertain, but that shall not make it unhappy while it lasts.

XXI

THE HEALTH OF THE AVIATOR: SAVING THE BIRD-MAN FROM EXTINCTION

FOR all its hugeness and complexity there is only one really new thing in this whole world-war, and that is air fighting. At first sight poison-gas might seem to be another, but, as a matter of fact, it is as old as it is vile, and traces its malodorous ancestry back to the Oriental stink-pots and the Greek fire, to say nothing of the cuttlefish, the bombardier beetle or stink-bug, and the black-and-white midnight ravisher of our hen-roosts. War has become, not merely terrestrial and aquatic, but celestial as well. For the aeroplane has carried it up into the heavens above, as the dug-out and the mine have carried it into the earth beneath, and the submarine into the waters under the earth.

Being new, the airman was and is yet a good deal of a puzzle to the professional military mind. There was first of all great difficulty in correctly placing or classifying him as to the arm of the service to which he belonged. He obviously did not march on foot, so he was n't infantry; he did not ride on a gun-carriage, therefore he could n't be artillery. But he did mount a steed of some sort, even if only a winged one, a



AN ADVANCE DRESSING-STATION NEAR THE LINE ON THE WESTERN FRONT

Pegasus; therefore he belonged to the cavalry. Consequently, through all the earlier years of the war, the aviator clanked about with spurs on his heels, which were just as useful to him as the proverbial second tail to a cat.

The airplane service, though it is new and will probably win the war in the end, has made, on the whole, the slowest and the most unsatisfactory progress of any arm of the service. Infantrymen — splendid ones, but of the same old brand that have been used in every war since the invention of gunpowder — have been turned out by the million; cavalry, by the hundreds of thousands, of the type that Attila used, and, as cavalry, just about as useful in the first three years of the present war as so many perambulators; cannon, by tens of thousands; while airplanes, which are the most hopeful chance of doing something new and decisive in the war, have, after four years of war, been turned out in only hundreds or even tens, although the cost of one is barely that of the useless chargers required for half a troop of cavalry.

One of the few disappointments of my six months' succession of visits, covering at least two thirds of the Western Fronts, including the Italian, was that the highest number of airplanes that I ever saw in the air at any one time was sixteen, and the largest squadrilla of planes, in regular formation and moving

as one, was nine, seven Capronis and two Nieuports sailing majestically over the Carso into the sunset to bomb Trieste.

On the other hand, I saw everywhere thousands of splendid cavalry horses doing the grasshopper act; that is to say, eating their heads off, and absorbing the services of nearly a third of their supposed riders, the other two thirds, after having been mounted and equipped to ride, regardless of expense, being dismounted, and used in the trenches as infantry. And when the Ministry of Food was created in England, and the people were urged to use as much as possible of oats and barley in the place of the precious wheat, it was discovered that there practically were no oats left, because they had all been bought up by the Army Commissariat Department for the use of the cavalry horses in France, and what few were left were more expensive than wheat. And there was shortage of barley, because most of it had been fed to the cattle and pigs and poultry to make up for the shortage of oats and wheat offal.

But then no respectable war, of course, could possibly be conducted without cavalry, and it is almost pathetic to see the eagerness with which the generals, the moment that the battle gets out into the open for a few days, jam a few troops of cavalry into the *melée* by main force and then turn round and proudly remark, "There, we told you

they would come in useful sometime if you only waited."

There was a story going the rounds among the Tommies when I was at the Front, to the effect that some one had actually had the temerity one day to ask a howling swell of a cavalry officer, what use the cavalry had actually been in this war. "My dear boy," said the exquisite, with an air of wearied condescension, "it has been simply of priceless value by giving tone and class to what would otherwise have been a mere vulgar brawl."

But the airplane has forged ahead after a sort, in spite of its being the Cinderella of the General Staff, though the darling of the general public, whose military instincts are often surprisingly sound. It developed certain internal difficulties of its own, chief among which was its astonishing infant mortality, equaling that of the vilest city slum; from twenty-five to fifty per cent of those who were "born" into its realm dying within the first year of flying life. The grimly pathetic epigram attributed to Guynemer, the ace of aces, that the successful flyer won first the Croix de Guerre, then the cross of the Legion of Honor, then the wooden cross, had a most painful amount of truth in it. The life of an aviator was variously alleged to be anywhere from three days to three months after he had fairly learned to fly. And what was worse, the mortality in training was said to be

almost as great as that in actual fighting and scouting. It really looked as though the war plane had settled the much-debated scientific problem as to why the flying lizards and dragons and other winged monsters of antiquity had become extinct.

For a long time this was regarded solely as a matter of the newness of the art of flying, the tremendous strains to which the planes were subjected, and on top of this, of course, the risks of war. It was dangerous enough just simply to fly in most weathers without having to run the risk of being potted by Archies and other anti-aircraft guns, to say nothing of enemy aviators.

But by great good luck the doctor was finally called in consultation, after some hundreds of the patients were already dead, and it was discovered, much to every one's surprise, that a very large share of this distressing and disabling mortality was due, neither to the enemy's fire, nor to engine trouble, nor to defects in plane construction, but to accidents occurring *inside the flyer himself*. A joint commission of Allied experts was appointed to investigate a series of some hundred successive deaths of airmen, and reported the significant and astonishing finding, that a very large percentage, indeed an overwhelming majority, of them were due to heart failure, loss of consciousness, or other sudden breakdown of *the aviator*.

Here evidently is most promising work for the doctor, and while, of course, this single set of findings is but a straw, even if future returns from our rapidly widening experience should cut in two the tremendous preponderance, it would still leave the risks of air fighting chiefly a medical problem; as largely so almost as were the old-time general war mortalities when six sevenths of all deaths in an army were due to disease: with the cheerful outlook that the present high life-risks of the flying man may be cut in two, if not to a fourth or a fifth of their former deadliness.

At all events, there cannot be the slightest doubt that all the possible resources of medicine and the allied sciences should be immediately called into action and concentrated on the problem of improving and protecting the health of the flying man. And this is why army doctors have been so eagerly urging, what has just recently been granted, the formation of a special Aviation Medical Corps, which shall have absolute and continuous control of the health and welfare of the aviator from the time that he comes up for admission to the service till he becomes a candidate for the wooden cross and needs "warning off" to save his life.

Although these findings of the tremendous part played by the health of the bird-man in his death risks astonished even the doctors, yet it fitted in with and

explained a number of other rather puzzling results of their experience.

One was, that there did n't seem to be any even approximately "accident-proof" type of airman. No matter with what flying colors a candidate had passed all his entrance tests, no matter how swiftly he became at home in the air, how completely he seemed to be a born flyer, for whom neither altitude, nor side slips nor nose dives had any terrors, sooner or later, one day, flying under perfect air and weather conditions, his machine would be seen suddenly to go out of control and come crashing downward, either to a fatal smash or perhaps to recover itself by a desperate effort within fifty or a hundred feet of the ground.

If the flyer survived, the only light that he could throw upon the accident would be, perhaps, that he began to feel sick at his stomach or commenced to turn giddy, or that his machine suddenly seemed to plunge out from underneath him, or, quite frequently, that he remembered nothing at all from the time that he was spinning along in perfect balance until he was being pulled out of the wreck of his machine or found himself in a hospital cot.

At first these unaccountable collapses were ascribed to the so-called "holes in the air," or small areas of lower density in the atmosphere due to vertical upward or downward currents of air, into which the

aeroplane "bumped" as a wagon might into a deep rut or chuck-hole. But it seemed rather difficult to prove the existence of such pitfalls on other grounds, and even if they existed as surmised, they would not have accounted for the commonest and most constant feature in the aviator's account of his mishap, a temporary loss of memory or of consciousness.

Then they were laid to a mysterious alleged "air-sickness," similar to the allied and familiar seasickness, and due like it to sudden changes and pitches in the equilibrium of the sufferer. But this again was found to be largely mythical, certainly at least in the sense of its being an experience which a majority of aviators had to go through in learning to fly, as the embryo sailor or the midshipman has to suffer the tortures of sea-sickness before he acquires his sea-legs. When we came to send up flyers by the scores and the hundreds, it was soon found that the majority of them never suffered from this balancing "air-sickness" at all — that is to say, not until they came to soar to high altitudes, when they encountered "air-sickness" of another sort; while, on the other hand, expert and seasoned flyers would be suddenly attacked by nausea and giddiness without any apparent cause, so far at least as their evolutions or the air conditions were concerned. In fine, all we could say was that a very considerable share of acci-

dents in the aviation field were due to some mysterious cause affecting the aviator himself, and could not apparently be accounted for by plane defects, weather, or the stunts which he was attempting.

Then another side-light was thrown upon the problem from a grim and pathetic angle, and that was the remarkable frequency with which aviators would feel and express premonitions of disaster just before going up for their final and fatal flight. Sometimes it would be a mere remark to some of his comrades or officers, that he believed the Boches were going to get him this time; sometimes the statement that he had n't slept very well and had had dreams of disaster, or that his head was feeling queer or his stomach uncomfortable, and he did n't believe he would be able to play up to his usual standard that day. But in other cases the premonitions seemed to have been so definite and convincing that they actually left letters or special messages for their relatives, or even instructions to their comrades as to what was to be done with their belongings if they happened to be "out of luck" that day.

Of course, many of these intimations of impending trouble have to be accepted with a good deal of caution and deduction. Even the bravest and most expert of soldiers or other men, when starting out to take a serious risk, have attacks of depression and foreboding, most of which come to nothing at all,

and for every prophetic or "second-sight" warning of disaster which comes true, there are probably at least ten or a dozen which happily prove entirely unfounded.

But we doctors have gradually come to regard a sense of impending death, especially early in a case of illness, or even, as sometimes happens, a day or so before the disease breaks out in open form, from a somewhat different point of view than that of prophecy or "second sight." While many of them fortunately fail to come true, those which do can be shown in a very considerable percentage of cases to rise out of the state of mental depression caused by the first flooding of the patient's blood with the toxins of the disease. In other words, they are the first symptoms of the disease itself, instead of any prophetic intimation of its approach beforehand.

These intimations and premonitions of the aviators fall very decidedly into this last category of coming events, which literally cast their shadows before by the impression that their first and advance attack makes upon the sensitive nervous system of their victims. And as soon as we began to question more carefully from this point of view the aviators whose accidents fortunately did not prove fatal, we found abundant evidence pointing in this direction. One flyer had noticed that he had n't much appetite for breakfast, and what little food he ate seemed to

disagree with him, and by the time he had got up only a few thousand feet into the air, he became nauseated, giddy, and momentarily lost control of his machine. Another complained before starting of a headache, which he attributed to being up too late the night before or perhaps smoking or drinking a little more than he should, and when he was performing one of his simplest stunts, his head began to throb, his hands seemed to become numb, and his "bus" went out from under him — and landed him in the hospital.

The higher he soars, the greater becomes the magnification of his trouble, so that apparently a discomfort or disturbance, which would have been no more than annoying and uncomfortable if he had remained on earth, is multiplied into a blinding or disabling disturbance ten thousand feet up.

In fact, one instance at least has been furnished of the actual demonstration of how a mere trifling disturbance on the ground may be turned into a serious interference with balancing power at a higher altitude, in one of our Air Board laboratories. It has been found that a large share at least of the disturbances, dizzinesses, etc., caused by high altitudes, is from the lack of oxygen due to the lowered air pressure. Consequently, candidates for the Flying Corps can be tested as to their ability to stand high altitudes merely by putting them into a large vacuum chamber

and gradually exhausting the air with a pump to the degree of thinness which would be found at an altitude of eight thousand, ten thousand, fifteen thousand feet. Two expert observers usually go into the vacuum chamber with the candidate and stand one on each side of him to keep track of the pulse, blood pressure, and general condition, so as to give warning when he is approaching any danger of collapse; they being supplied with tubes in their mouths through which they can inhale oxygen, are able to work in almost perfect comfort. And it is quite a curious contrast to watch the labored breathing and the pale or flushed countenance of the candidate, as the pressure is lowered, while the experts on each side of him remain fresh-colored, breathing easily, and completely absorbed in their observations.

But one morning, one of the observers had n't cared much for his breakfast, and what he did eat did n't seem to agree with him, and after he had been in the vacuum chamber with one candidate after another for an hour or so, he began to feel an uncomfortable sense of tightness and constriction about his waist-line. Almost without thinking what he was doing, he most injudiciously unbuckled his belt and unbuttoned the two upper buttons of his trousers, when immediately, under the extremely low pressure at which he was working, his stomach, as he expressed it, "bulged up like a balloon" and caused him such

acute discomfort that he had to signal to be let out of the chamber.

What had happened was, that the acid fermentation of the food in his stomach had caused the production of a certain amount of gas, which at ordinary air pressure would merely have made him slightly uncomfortable. But as soon as the pressure of the air in the chamber had been reduced below that of the gas in his stomach, it proceeded to balloon up and cause painful distention of its walls, which might, if he had been actually flying and still rising higher, have produced very severe pain and even unconsciousness, before he realized what was the trouble.

Of late the same tests can be made, without the expense and trouble of a vacuum chamber, by allowing the candidate to exhaust the oxygen out of the air of a container by simply breathing it over and over again till its rarity corresponds to ten thousand, fifteen thousand, twenty thousand feet of altitude and noting the results.

The evidence is overwhelming that one of the great mottoes both of the aviator and his Army doctor should be, "Despise not the day of small things." The same gospel was already being preached by the experts connected with our Air Board laboratories and testing-stations. As every one knows, candidates for admission to the Flying Corps are put through

about the severest "third degree" of an examination for physical fitness that can well be imagined: not merely the ordinary Draft Board tests for soundness of heart, lungs, limbs, nerves, and senses, but a whole battery of special tests, of eyesight, of hearing, of balancing powers, or capacity to stand high altitudes, and a full series of psychologic tests to try out their mental and emotional possibilities.

In the beginning and for a considerable time after it was believed, not unnaturally, that the aim and result of all these tests would be to pick out among thousands of applicants a few score or hundreds of exceptional men peculiarly fitted for the new and unconquered field of the air, a sort of human bird, as it were, men who did n't know what the fear of falling was, whose balance centers or semi-circular canals could not be disturbed or dizzied by any amount of whirling blindfold on spinning tables, and who would not gasp for breath at the highest altitudes, men who were born to fly as the fish is to swim.

But gradually, as experience in the new and untried field piled up, it was found, first of all, that this type of born flyer who could stand any amount of altitude and whirling and looping was a distinctly *rara avis* — without any pun being intended. Secondly, that when this fortunate freak or prodigy was discovered, he was almost as liable to sudden and unaccountable accidents and mishaps as any one else.

Third, and most important, that any vigorous, healthy, intelligent young chap, with a sound heart, a good pair of lungs, a healthy digestion, and normal eyesight, hearing, and balancing powers, could learn to fly within ten days and develop into a perfectly competent average aviator. To make an ace requires a touch of genius, but for nine tenths of the routine work which an aviator is called upon to do — bombing, photographing, observing, fighting in regular formation — all that is required is sound health, keen senses, and good average judgment and intelligence. "A man wid two hands an' two feet an' all his teeth in his head," as Mulvaney puts it. The Navy experts frankly declare that almost any man who can drive an automobile can learn to fly.

So that while not relaxing the thoroughness of their examination, the Air Board experts are, so to speak, rationalizing their standards, feeling that they will get better results by admitting vigorous, healthy, normal young men, putting them under ideal physical conditions and the most watchful observation of the doctor, and then completing their test by actual experience in the air itself. First, in the "dummy" machines, which skim about in all directions over the field, but never really leave the ground for more than a few yards at a time; then in a double-seater with an experienced pilot and coach, and weeding out ruthlessly those who do not quickly become at

home in the air and lose practically all fear of it in a week or ten days, or who seem to have difficulty in keeping cool and clear-headed and meeting easily and enjoyably the ordinary emergencies of simple flying.

If the doctor is "strictly on the job," the risks of this preliminary probation would be slight, and it would result in the prompt weeding-out of a certain number of men who for their own best good, as well as that of the service, ought not to be allowed to fly at all. It seems to be the unanimous opinion of aviation physicians and experts in all the Allied countries that there is a certain percentage of men with perfect physical health, and who can pass all the most rigid tests for sight, hearing, balancing powers, etc., yet who can never learn to fly with either comfort or safety. If this type were keenly watched for and promptly weeded out within the first two or three weeks, and the much larger proportion of candidates who take to the air easily and readily were kept under constant expert observation, and never permitted to fly either in training or actual war work except when they were in perfect physical condition, it is believed that a very large majority of the fatal risks of flying would be obviated entirely.

Most aviators of experience are quite well aware of the dangers of going up when not physically fit. They enjoy life and its pleasures as keenly as any

other healthy, high-spirited youngsters, but most of them decline to smoke when on active service, and many of them abstain from alcohol altogether for days before a flight, or, if from the wine-growing countries, take only most abstemious amounts of the lightest of vintages. Though they are left almost entirely to their own discretion in these matters, they have found that late hours and burning of the candle at both ends of all sorts simply do not "consist" with that perfect clearness of head and keenness of judgment which is absolutely necessary to safe and successful flying.

In fact, the code of the aviator has become that of the athlete, raised to the *n*th power, clean, cheerful living, self-restraint, self-control, well repaid by the exhilarating sense of fearlessness and fitness for anything. Their chief dread is of nervous exhaustion, which shows itself in the form of worrying and lack of confidence, and inability to judge distances properly. Its first warning symptoms are bad dreams and nightmares, usually connected with the risks of their work, among which machine guns jamming and two Boches "diving on your tail" are the most frequent and significant. When these visions begin to make night hideous, they know that their only safety lies in two or three days of complete rest. Warnings which come in dreams are usually regarded with well-merited suspicion, but in this particular case they

seem to be painfully liable to "come true" in the shape of an accident or mix-up, if their danger signal is disregarded.

Another potent way in which the safety of the bird-man can be guarded is by the intelligent use of oxygen. When the aviator spirals up to an altitude of eight or ten thousand feet, he comes into the danger zone of what has long been known as "mountain sickness." This is an extremely distressing and uncomfortable condition, of intense depression and sense of muscular weakness often accompanied by nausea, vomiting, and giddiness, which attacks those who climb high mountain peaks.

Ever since men began to climb high mountains or to go up in balloons, it has been known that above a certain altitude they became subject to various discomforts, as shortness of breath, pain in the ears, and sensations of giddiness from changes of pressure upon the ear drum, and hemorrhage or bleeding from the lips and throat or from the ears, due to the sudden lowering of the pressure upon the blood vessels near the surface. That these changes were due to the rarity or thinness of the air on account of the fact that its pressure steadily diminishes as one climbs upward from the sea-level was early recognized, but it was always a problem as to how much of it was due to direct action of the lowered pressure upon the body surface and the blood in the blood vessels, and

how much to the lowered pressure of oxygen, and consequently smaller amount of this most vital gas which could be drawn into the lungs at each breath.

Recent investigations, however, both by a group of American scientists in their famous expedition up Pike's Peak, and by Italian and French experts, have shown that the lion's share and probably the overwhelming majority of all the most distressing and disabling of these symptoms are due to the lack of oxygen alone and can be avoided or prevented by judiciously inhaling a supply of the gas from a cylinder or the container. This is a finding of immense practical importance, because, obviously, if what has been proved in high mountain altitudes holds good for the same altitudes in aviation, then by supplying, with cylinders of oxygen and a proper inhaling mask, all flying machines which are expected to go above eight or ten thousand feet, another very considerable share of the risks and dangers of high flying can be either prevented entirely or very considerably diminished. Experts upon both sides of the battle-line are now actively engaged in testing out this question and in devising some form of container which will combine lightness with bullet-proofness, and an inhaling tube or mask which will properly regulate the supply of oxygen for the airman.

The problem is a difficult one, partly because space in the narrow body of the fuselage is already at the

highest possible premium, and every available gap or angle of the airplane is packed and crowded with controlling or fighting or protective mechanical devices of every imaginable sort; partly because the wearing of a mask through which to inhale the oxygen would be likely to interfere a good deal with the freedom and fighting powers of the airman, while, if inhaled directly through a tube, it would have to be kept flowing at very low pressure or else considerably diluted with some other bland gas, in order to prevent irritation and even mild burning of the mouth and throat.

But in the bright lexicon of science there is no such word as fail, and if it is shown that the proper use of oxygen will prevent much of the stress and heavy wear and tear of flying at high altitudes with frequent changes, and will diminish the aggravation of comparatively slight disturbances of health into disabling distresses high up in the air, some apparatus will unquestionably be devised for supplying our flyers with oxygen. So far as tests conducted in the vacuum chamber on the ground are concerned, it has already been pretty conclusively proved, both by Italian and American investigators, that at least three fourths of the sensations of discomfort, fainting, nausea, etc., can be completely prevented and abolished by the use of oxygen. An Italian expert has even been able to stand with perfect comfort a

lowering of pressure corresponding to an altitude of over forty thousand feet, simply by inhaling a gas-mixture of oxygen and carbon dioxide, the other gas which is present in our blood. This elevation, of course, is far above anything ever yet achieved by either mountain climbers — for the very good and sufficient reason that there isn't anything high enough for them to climb on to that level — or aviators.

That the height of the flying has a marked effect upon the risks of the bird-man is most strongly suggested, if not actually proved, by the almost appalling table of "life expectation," worked out by a combination of English and American air experts, of the different classes of flyers. At the top, in the double sense of nearest to heaven and most liable to ascend to it at any moment, comes, as would have been expected, the combat man or fighter, who has to fly at heights ranging from sixteen to twenty-two thousand feet, and whose average "life" is from one hundred to three hundred hours of actual flying, which means from one to three months. I must hasten to explain, however, that the term "life" does not mean the literal physical life of the aviator himself, but the length of time which he can, as the saying is, last in the air, after which he is extremely likely to meet with some disabling or fatal accident, or, if his guardian physician and superior officers are properly

alert, to be transferred into some other branch of the service or to a staff position or a post as instructor.

Next comes the observer flying at from ten to sixteen thousand feet, and whose "life" is considerably longer, namely, from three hundred to six hundred hours of flying, or from three to six months. Last and safest of all comes the night bomber, whose particular task requires only peaceful altitudes of from five to ten thousand feet, and whose "life," though less exciting, is noticeably and gratifyingly longer, namely from seven to nine months.

Altogether, the outlook for the flying man, the warrior of the future, is very much less serious and more hopeful than was at one time feared. What his actual mortality up to the present is and has been is jealously preserved as a military secret, so that it is difficult to make any definite prediction, except to say that we may confidently expect a marked reduction of it in the near future.

First, by developing a system of aerial medicine and training an aviation medical corps, and putting the welfare and the interests of the bird-man absolutely and entirely under their control from the time that he presents himself for admission to the service. Second, by improving and rationalizing the present series of tests and extending it to include mental, emotional, and judgmental powers, and giving each candidate a thorough practical try-out in the

air under the most vigilant supervision, both medical and aeronautic, before deciding upon his admission or rejection. Third, by the utilization of oxygen as a preventive of some of the most serious risks of air-sickness and other conditions liable to cause loss of consciousness. Last, but not least, by having the aviation doctor live with and "mother" him as a trainer does with his crew or team; watching him like a hawk for the slightest appearance of trouble or deviation from normal balance, and then absolutely forbidding him to fly except when in perfect condition. This will mean the having in reserve, as it were, a somewhat larger number of men for each given number of machines, so as to be sure that there will always be a sufficient number of competent flyers in proper condition for flight. But there can be no question that it will result in the checking of a most pitiful waste of splendid young life and the reduction of the risks of the bird-man in his new element to less than half if not less than one fourth of their present level.

XXII

THE UNIVERSITY OF THE ARMY: WAR AS A COLLEGE COURSE

WAR is the oldest game in the world, but the rules are always changing. On account of its dramatic appeal and our age-long ancestral worship of courage as the supreme virtue, our imagination persists in thinking of the war game as if it were still played according to the rules of the last century or the century before last.

So deeply have historic and other forms of romantic literature impressed upon our mind's eye the picturesque aspects of warfare that we simply cannot rid ourselves, in spite of the evidence of our senses, of the idea of war as a matter of flying colors and glittering accoutrements and dashing cavalry charges with waving of swords and shouting of war-cries.

When we send forth our boys to do their part in making the world safe for democracy and keeping life worth living in the future for those who would be free, we are apt to think of them as going into a world totally different from their past, where their sole aim and occupation will be risking their lives trying to kill other men or to keep other men from killing them. Something which has not only no connection with

their past, but no bearing upon or relation to their future life and work after the war is over.

As a matter of actual fact, probably less than ten per cent of their time will actually be occupied in the dangerous and exciting duty of actual fighting. And while the whole of their training and coöperative activity and mental teamwork is directed toward "this brief, fierce hour of glorious life" and getting the better of the enemy, yet the means which are employed in leading up to this crushing blow on the enemy's lines are the very latest and most up-to-date forms of modern, industrial, and social organization and scientific efficiency.

Modern war has become one vast engineering and reclamation enterprise with a fighting edge on it. Every human faculty and gift and power which is useful in peaceful life will find its field and scope and occupation in modern war. As Sir Auckland Geddes, England's Director of National Service, has recently put it, "Every man who is capable of earning a living in peaceful life can be made use of in a modern army."

In the first days of the war, when the crying need was to rush forward some sort of a human barrier against the devouring Prussian flood, there was no time for making distinctions of capacity and special fitness. Any one who was brave enough to offer his life for the defense of his country, and physically fit and vigorous, was eagerly and gladly accepted, and

sent out to the firing-line with as brief a delay as possible for obtaining an equipment. But as soon as the war had settled down into its form and the real nature of the seriousness of the struggle became apparent, an actual combing-out had to be made of the regiments on service at the Front for the purpose of bringing back the men who had special mechanical, engineering, and scientific training, for the purpose of putting them into munition factories and on the railroads and on the telephone and telegraph lines supplying and supporting the armies at the Front.

So new and unforeseen was this demand of modern war that even in Germany hundreds of thousands of men were withdrawn from active service at the Front to go back to munition factories, electrical and chemical works, and later even to special branches of agriculture, in order to keep the fighting-line supplied with the sinews of war. As Lloyd George declared not long ago in Parliament, "It takes three and four women at home on the land, in the mines, in the shops, and on the railroad to maintain and supply one man on the fighting line at the Front."

Nowadays when a man is enlisted or conscripted for service a careful inquiry is made as to his previous training, experience, and aptitude, so as to see for what particular group of the innumerable callings which go to make up the modern army he is best fitted. If he knows how to run and repair a car, he

will very probably be enlisted at once in one of the various branches of the transportation service. Next to the railways long lines of motor lorries and trucks bearing food, supplies, and ammunition are the literal life-blood of an army, without which its striking muscles would quickly fall paralyzed and helpless.

If he has had experience in the Big Woods he may be drafted into one of the army lumbering gangs, which with portable sawmills are invading the ancient forests and woodlands of France and cutting down and sawing up the monarchs of its glades to make barracks and sidewalks and trench revetments for the Allied troops. Thousands of Canadian lumberjacks have been specially enlisted in the Army for this purpose, and you hear the whirr of their saws and the ringing of their axes in the historic woods and beautiful groves all over England, sacrificing the oaks of the Druids and the sheltering groves of the noblest mansions, for the defense of freedom.

Should he have had familiarity with electrical installations or with telephone or telegraph work, there is a whole range of berths in these Intelligence and Signal Services which are open to him. Not only are new lines of communication being constantly built, but unlike in civil life the old lines will not stay put, but are continually being destroyed and interrupted so that a continuous exercise of ingenuity in reconstruction is constantly necessary.

If he knows anything about pumps, or mining, or drainage or water-supply, he will be eagerly snapped up by either military engineers or sanitary officers and employed upon vitally important military service, even though it has nothing directly to do with participation in the actual fighting.

Has he "an eye for country" or some experience in surveying and knows how to draw maps and plot out contour lines, there is a wide field for him in the surveying department of the various headquarters staffs.

Should he prove an adept in the greatest and most important of all arts, the handling and moulding and controlling of men, there are a score of eyes constantly upon him to detect the first blossoming of ability in this direction. And his rise in rank on an average will be found to be as rapid and as free from personal favoritism as in any business or occupation at home. Not only is every officer worth his salt eager to get the best and most competent non-commissioned officers that he can find among his men, but there is also now a formal Army order in both the British and the French forces requiring each and every colonel to recommend every three months a certain minimum number of men and non-commissioned officers from the ranks of his regiment for promotion to a cadetship in the Officers' Training Corps.

A modern army in the field is a complete, perfectly organized, self-contained, bachelor community. Save for the fact that all its members are vowed to temporary celibacy, the whole length of the Western Front is like one continuous industrial village or model suburb, with all the mills running at full blast day and night. With all its hatefulness and hardships trench warfare, instead of being a round of dull and dreary outpost duty, with monotonous killing of time in comfortless camps, is one constant, busy, enterprising push and struggle against the enemy, with all the methods and resources of modern science, as active, as bustling, as resourceful, and far more interesting and exciting, than even successful industrial business or professional life in peaceful times at home.

There are as many different trades and occupations running full blast in the war zone as there are in an urban community at home, and all of them plied by soldiers. The War Department recently advertised for men urgently wanted for the needs of the Army, skilled in *sixty-six* different trades! "Tinker, tailor, soldier, sailor, rich man, poor man, beggar man, thief, doctor, lawyer, Indian chief," with the delightful and refreshing exception that there is neither "poor man, beggar man, nor thief" in the war democracy. The only articles of property which Tommy or Alphonse seems to be in the least afraid

of losing in camp are dogs, war relics, and pipes, which are regarded as "wild game," like umbrellas and watermelons at home.

"Tinkers" are legion both in numbers and kinds, for the wearing-out and breaking-down of every kind of a plant and equipment in war is from five to ten times as rapid as in peace, and a man who has a craft or a natural gift in any and every imaginable variety of the repairing and reconstructing line, from the cobbling of shoes and mending of belts up to the straightening of rifle-barrels and the curing of engine troubles in autos, or of the intestines of howitzers, or the rejuvenation of "driven-down" airplanes, can find abundant and constant occupation. The life of a magazine rifle, for instance, in actual service is said to average about two to three months; that of a motor on war duty about six weeks.

The whole purpose of the steady cataract and avalanche of enemy shells poured upon our lines every day of the week and every week of the month, is to fill up and obliterate trenches faster than they can be dug out again. Hence everybody in the trenches works, constantly thickening bomb-proofs and dug-outs, strengthening their roofs, and burrowing more deeply underground, to keep himself shell-proof; the moment you quit you're "snowed under."

(The so-called fixity and rigidity of trench warfare

is in one sense only apparent. Armies to-day have to work harder to stay in one place than armies of the open warfare of yesterday had to advance a hundred miles. The mere repair and upkeep of the trenches for the firing-line and of dug-outs, bomb-proofs, and underground galleries for the troops in support behind the third trench, will occupy a third of the total man-power of the army. A trench is literally moulded upon and supported by the bodies of men, and is perpetually changing and growing like a live thing. It has to fit the bodies of the men who occupy it like the cell of the honeycomb does the working bee. Roughly speaking, it can be only six inches deeper than the height of the tallest man in it, and about six inches wider than double the depth of his body from chest to back. Most first-line trenches are dug just wide enough for the men to be able to glide past one another by turning sideways.

They must fit the holding troops like a suit of clothes. If they are too shallow, obviously the heads of the men will be exposed to the horizontal flying fragments of shells which strike on the surface in front or behind them. If they are more than a foot above the heads of the men, there is danger, when a big shell crushes in the front wall, of burying them so deeply that they will be unable to dig their own way out. Their extraordinary and inconvenient narrowness is due to the stern mathematical fact that,

whereas the only shells that can inflict serious and extensive damage on the men are those which fall directly in the trench, obviously a trench which is three feet wide is just twice as dangerous as one which is only eighteen inches, and greater widths in proportion.

Front trenches cannot be lined or strengthened to any considerable extent with stone or iron plates, or even wood or cement, for the reason that while men can work their way out or be dug out from under a foot or even two feet of loose earth before they are smothered, it is a much more serious and dangerous matter if the cave-in carries with it beams, or stones or iron plates to trap and crush bodies and limbs; while in the case of stone and wood the splinters which will be sent flying by a shell-burst may be almost as dangerous as the fragments of the shell itself.

If the men are left entirely to themselves, they have a natural and pardonable tendency to burrow steadily deeper on "Safety First" principles, although this again is considerably checked by the likelihood of striking ground-water in most soils when you get below a moderate depth. The champion performance in this line which I saw was that of a canny and elderly French regiment, which had held trenches in a firm, well-drained soil for many months, and had gradually, almost unconsciously, lowered them

to the luxurious depth of *eleven feet* so that they had to use ladders to get up on to the fire-step! But this was an eccentricity, and the bitter experience of years of actual warfare has clearly shown that deep trenches, in spite of their comfort and sense of security, like too deep and elaborate dug-outs and underground chambers, have proved more dangerous as traps for the burying and suffocating of whole bodies of troops or for their capture as prisoners than helpful in protecting against shell-fire.

In short, human bodies holding and moving about in shallow runways in the soft surface of Mother Earth have proved the only real fortifications in modern war, the only barrier which can defy the terrors and check the advance of the hugest guns and the highest explosives.

So that the term spent in the front-line trenches is not just simply a period of vigilance, hardship, and passive exposure to danger, but one of almost incessant repair and construction and extension. No trench left to itself would last forty-eight hours under modern shell-fire. The same is true even in a higher degree of the much longer period spent in reserve and rest camps behind the lines. On account of the extraordinary range of modern big guns and of the tremendous part played by bomb-dropping airplanes, the destruction which is being incessantly wrought far behind the lines upon camps, barracks, shelters,



INDIAN SOLDIERS CARRYING IN ONE OF THEIR OFFICERS

and villages, railheads, hospitals, roads, and light railways by enemy fire is second only to that in the front-line trenches themselves. This, added to the natural effects of the elements, makes incessant repair and reconstruction the standing orders of the day. And to suppose that time hangs heavy upon the hands of the soldiers, even in reserve and rest camps, would be a great mistake.

On the contrary, so active have become the demands of enthusiastic officers, with a keen eye for repairs and improvements, especially since road-building and agriculture have been added to the regular military duties of an army, that the soul of Mr. Thomas Atkins has been seriously and resentfully disturbed. He left his happy home and came out to France to fight, not to plough fields and dig ditches and build roads and bridges and model barracks.

I was actually told, on one section of the Front in Flanders that I visited, that the men had sent a delegation to the general commanding asking to be allowed to spend more time in the front trenches and less in rest and reserve camps, where these irksome and degrading fatigue duties were demanded of them from morning to night! This is interesting both as showing what an active, busy life the modern soldier's has become, and second, how lightly the seasoned soldier holds the horrors of modern shell-fire

and the rack and agony of that terrible modern war strain which we hear so much talk about.

Scarcely an aptitude or capacity of the human life can be imagined which cannot be given full play and scope in the industrial democracy of modern war. Indeed, it would hardly be too much to say that the man who is just plain fighting man and nothing else is the exception and not the rule. Not only is there this wide range of opportunity for development from the general and the doctor and the judge down to the cobbler, the tailor, and the cook, but each one of these has its open and recognized line of promotion and advancement to almost any degree of authority and usefulness. The leading positions in, say, the commissariat department, in the army service corps, in the quartermaster's service, in the construction and engineering department, are as influential and honorable and as well paid as almost anything in the pure line itself.

To become a member of a great community of service, sinking individual and selfish interests in devotion to a common end, is in itself a wonderfully broadening experience and a liberal education. Although organized for destructive instead of constructive purposes, the atmosphere that one becomes keenly conscious of in the great military democracy of the Front is one almost Utopian in its justice, its fairness, and its eagerness for mutual helpfulness and service.

XXIII

THE ARMIES AT PLAY

LAUGHTER is to the spirit what sunshine is to the air; neither can keep sweet without it. And the soldier must laugh even oftener than the civilian, because his life is harder and more dangerous. He has so much of the bracing, stinging frost of danger and of the dreary, chilly rain and sleet of hardship, that he must have frequent periods of the sunshine of laughter and enjoyment, or stiffen and sour under the strain.

The thing that brings home most forcibly to the visitor at the Front that a modern army camp is a full-blown, self-supporting community, a real city under canvas, or town under tar-paper, is neither its size, which is often that of a State capital, nor its steam laundry, its huge dining-halls, its wooden sidewalks, its general store, its tobacco and candy shops, its soda-water fountains, its bank and express office. It is the fact that its largest building is a moving-picture theater and concert-hall, its most attractive out-of-door space, the primitive little platform or "players' pitch," with booth-like dressing-rooms set at the foot of a circling rise of the ground, or in the hollow between two hills, so as to face a natural amphitheater,

where plays and open-air spectacles, or lectures and patriotic addresses can be given to three or four thousand soldiers at once.

Next after these come the football field, and in an American camp the baseball ground and stand — though “grand” it could hardly be called. Then, as one watches the streams of bright-eyed, vigorous humanity which pour through the streets of the army town after the bugles have blown in the afternoon for rest and play and follows the principal current, one quickly comes to that matchless soldiers’ club and refuge of homesick hours, the Y.M.C.A. Hut. This “hut” is a rough but comfortable wooden hall from forty to eighty feet long, where concerts and lectures and “chalk-talks” and “sing-songs” and “smokers” are the continual order of the day, or rather of the night. Classes in French and history and literature and chemistry and other sciences are provided for the educationally disposed, and manly, kindly, practical talks on applied Christianity, with the dear old familiar hymns. The officers of the regiment, the Colonel, the Quartermaster, the Doctor, come in and talk with the young soldiers in an unofficial capacity, so to speak, giving them fatherly advice and information on the standards, the high traditions, the duties and the temptations, the glory and the rewards, of a soldier’s life.

How popular and well appreciated they are may

be glimpsed from the fact that the only complaint which one eager young secretary made to me was the smiling one that the hall was n't big enough to hold half the crowd that wanted to get in to the talks and concerts, and that the "overflow" would insist on crowding every window so full of heads as almost to cut off the supply of air for those inside.

Between entertainments the hall is filled with little tables for writing home, reading, and playing games, a good supply of newspapers, magazines, and recent books being kept on hand. Nor are creature comforts by any means neglected: each hut has an excellent canteen and lunch-counter, where soft drinks, hot coffee, pie, eggs, sweet-stuffs, and other home-like delicacies, not included in the Army ration, are supplied all through the afternoon and evening. The prices are very moderate and any profit which may be made is applied to the upkeep of the hut.

In our American camps these Y.M.C.A. Huts are supplemented by regimental canteens with reading- and writing-rooms, and in the English camps there are either Church Army Huts or Salvation Army Huts, with similar equipment and programmes, only with not so many concerts and lectures and educational features. All these organizations are doing most valuable and devoted work, and it need hardly be said that those of religious character and spirit, while staunchly true to their ideals, are magnificently

"long" on human helpfulness, home-like sociability and comfort, wholesome amusement and intelligent recreation, and mercifully short on formal theology and nice dividings of doctrine.

The only approach to any display of doctrinal prejudice was the resentful and spontaneous outburst on the part of a peppery old General when requested to provide quarters for the Salvation Army: to the effect that he'd be hanged if he'd submit to the idea getting abroad that the soldiers of his division were bad enough to need converting by hallelujah methods! This, of course, is a matter of individual opinion, but after one has actually seen a few hundred thousand fighting men of this war on the Front and found what manly, kindly, self-controlled, splendid fellows they are, one begins to feel a distinct sympathy with the good General's resentment.

And when the Salvation Army actually got into the war it proceeded to play pies, doughnuts, and hot coffee under fire as its "long suit," with kindest fatherly advice and assistance and motherly care and services instead of cymbals and hallelujahs. Few agencies have got closer to the hearts of our boys in France than the Salvation Army.

It would be hard to speak too highly of the splendid services rendered by the Y.M.C.A. on both the English and American Fronts. What the military authorities and the Government themselves think of it may

be seen from the fact that one of its chief secretaries in London, Sir Arthur Yapp, was knighted over a year ago and has since been asked to assume, in addition to the secretarial and Army Camp duties, the leadership of the great food economy campaign, so that he has become one of the most prominent and influential men in England.

The courses of lectures and concerts and other entertainments are by no means limited to local talent or chance volunteers. On the contrary, a regular entertainment bureau has been organized, which secures not only lecturers and entertainers from all over the United Kingdom, but also prominent ministers, lawyers, doctors, and scientists, who are sent out on regular tours of speaking and lecturing all along the Front and through the Training-Camps at home. Some of the ablest speakers and writers volunteer gladly for this service, and it is hardly too much to say that the average soldier, unless he has come from a great metropolitan center, has a finer or better opportunity to see and hear the best and most worth-while of both men and ideas than he could have had in his own home neighborhood.

But, as if even this were not enough, about the second year of the war there came a demand from the men themselves for even more serious and systematic information and instruction. I was greatly interested to find last spring that the English Govern-

ment was sending out to the camps at the Front some of its greatest teachers and leading authorities in all sorts of fields, such, for instance, as naval affairs, the problem of modern aeronautics, international law, modern history, chemistry, French and English literature, and arranging for them to give short courses of lectures in their special subjects, followed for those who wished it by a sort of University Extension examinations. Just to mention a few of the best-known names: Mr. H. G. Wells, Professor Arthur Pollen, the naval expert, Professor Gilbert Murray, Dr. Frederic W. Mott, the famous pathologist, and Sir Frederick Treves, one of the surgeons to the Royal Family, and other men of like caliber.

On the athletic side of its play an English or American Army Camp is like a well-organized college or high school. In the first place, while the great movements of the armies are on the most massive and formal scale, there is a surprising amount of scope left for individual initiative and ingenuity of junior officers, sergeants, and even the men themselves, in planning and carrying out those innumerable little private entertainments and local vendettas known as raids, patrolling movements, and "feelers."

The tactics of these little fracasés are as elaborate, as involved, and as mysterious as the strategy and signals of a football team. Every detail is worked out and rehearsed for days and even weeks in ad-

vance, and the ingenuity and enthusiasm expended in planning something new "to put over on Fritz" is something incredible, and about as stimulating intellectually as anything that can well be imagined. Every last private must not only understand perfectly the whole scheme and be letter perfect in his own part, but often be ready with two and sometimes three alternative courses of action in the event of any part of the scheme miscarrying. No Man's Land after dark is no place for a "bonehead."

Never before in war was so high a premium placed upon individual intelligence and initiative, and on direct observation one begins to discover some little basis for the consoling belief that, in spite of the wholesale destructiveness of modern warfare, intelligence does distinctly increase the chances of survival.

On the lighter side of athletic life every regiment has its football team, its tug-of-war team, its champion sprinter or hurdler, or putter of the shot, and meets and field days of all sorts, including even boxing tournaments, are held as regularly, and far more enthusiastically, than regimental inspections.

All sorts of unexpected faculties and habits come in useful in war-time. The most distinctive feature, to a Northerner, of a Latin town or village, whether Mexican, Cuban, French, Spanish, or Italian, is that it possesses a plaza and has the boulevard habit. Both of these institutions are ostensibly intended for

special functions of their own, the plaza being a formal, central square or park for the grouping and enhancement of public buildings and official residences, while the table-covered terraces of the boulevard are a mere overflow from the cafés which border it.

But the real function and excuse for existence of both of them is their frank recognition of the eternal truth that the darling study of mankind is man, and the superb facilities which they furnish to the entire community, from the lowest to the highest, to enjoy freely this keenest and most lasting of pleasures: to see and to be seen, to talk and to listen, to feel one's self warmly and actively in touch with all the currents and interests of one's kind; in short to be "in the swim," "on the spot," as our English cousins say, "in the know." Here one can stroll and be looked at or sit and pass judgment, can hear the freshest gossip, pick up the most confidential of news, and retail the spiciest of scandals.

So important, in fact, do most Latin communities hold this side of life that they deliberately devote, not merely all the languorous summer evenings, but from two to three hours in the middle of the winter day in the cafés to this form of intellectual exercise and development. And a man's standing in the community, even in so busy and bustling a city as Paris, is often determined almost as much by his social

gifts, or powers of eloquence and reasoning in these open forums as by his financial standing or his political or professional abilities.

This habit and tendency form a wonderful asset and advantage when it comes to providing entertainment and recreation for an army in the field. In the French Army Camps the formal entertainments and educational features are taken care of by the "Foyer des Soldats," or "Soldiers' Hearth," a very cheerful and useful men's club, but with a less extensive and complete organization than the Y.M.C.A. or the Official English Lecture Courses, for the greater part of the men's recreation is spontaneous and unofficial. Every one who lives long among the French people is struck by the fact that they have a much greater capacity for entertaining themselves than have we more chilly and self-contained Northern races. They are less self-conscious, are far better conversationalists, and have much easier and more natural graces and manners. So that the mere society of their kind is to them a perpetual feast, and a package of hayseed tobacco, with a couple of "mazagrans" or glasses of light wine, and a dozen or fifteen of their comrades and cronies, will provide never-failing entertainment and delight three hundred and sixty-five nights out of the year.

The conversation in many of these camp-fire groups and dug-out debating societies is excellent, some of

the most entertaining and informing that I have ever listened to, even under the handicap of an imperfect apprehension of all the subtleties of the eloquent but elusive French tongue. Every grade of intelligence, every type of interest, every social viewpoint is represented in the rank and file of the French Army. The shaggy poilu, in faded blue tunic and ploughboy boots, who sits on the cracker box opposite, may be a famous artist with scores of successes in the Salon to his credit. The trim young Sergeant, proud of his honor stripes, who sits next to you, may be a rising poet and darling of the cafés of the Quartier Latin; while the burly, grizzled Major on your left may be a lecturer at the Sorbonne or an eminent authority on international law.

Nor is this a mere fancy sketch. In one single headquarters mess in a little country inn in the Vosges, whose guest I was, one academic or scientific title after another was mentioned, until I asked permission to make formal count, and we found around the plain pine table no less than five college professors, one Academician, a former Deputy of the French Parliament, and a well-known essayist and critic. And on my visits to the French Front I found myself looking forward eagerly all day to the evenings spent over the coffee-cups and the decanters with the officers, whose ready wit and glancing humor, whose eloquence and gay delight in defending

the most daring and startling of paradoxes, whose keen logic and brilliant criticism form some of the happiest memories of my entire trip.

Even the rank and file of the French Army are for the most part surprisingly well read and well informed on most of the subjects of the day — *except* any history, or geography other than that of *la belle France*, everything outside of whose thrice happy borders is a wilderness and desolation to them. And they can weave the most beautiful and animated and eloquent evening's conversation out of the ideas suggested by a mere handful of insignificant facts, which would scarce have provided material for a dozen responsive grunts between phlegmatic and unimaginative Anglo-Saxons.

The French camps have excellent official theaters and moving-picture shows, and whole companies of famous actors and actresses and vaudeville stars volunteer their services to travel up and down the lines and bring pleasure and relaxation into the lives of those who have devoted themselves to the defense of their country.

Similar organizations and arrangements exist along both the English and the Italian Fronts, and one of my most picturesque memories is an open-air theatrical performance that I attended in a beautiful little bowl among the hills, just at the foot of the Carso, where a company of actresses and actors from

Milan presented with spirit and vigor two charming little comedies before almost half a division of Italian soldiers, over four thousand strong. The huge delighted audience of Bersaglieri in their sweeping cocks'-plumes, of infantry and artillerymen in their shimmering gray, and of Alpini in their green Tyrolese hats and deers' tails, was most appreciative, but keenly critical as well. One music-hall favorite had omitted one of the sauciest verses of her song out of deference to the dignity of the Generals of the Headquarters' Staff who filled up the front rows with their stars and ribbons. The soldiers noticed the omission at once, and when she came back for her encore they shouted loudly, "Sing the other verse, signorita! Never mind the Generals; they won't care, and the Censor is n't here!"

The only other disturbance of good order was when an impudent Austrian airplane came zooming over the Carso and tried to get near enough to break up the show with bombs instead of cabbages and eggs. But a couple of Italian machines promptly shot up and chased him away before he could get near enough to do any damage.

The reading-room, letter-writing, and light restaurant accommodations for the Italian soldiers are provided by the wooden halls known as "Casa dei Soldati." These are equipped and generously supported by the larger Italian cities—Milan, Turin,

Bologna, Florence — and are gratefully appreciated by the soldiers. But when it comes to entertainment and amusement, the Italian soldier can take care of himself even better than his French comrade. He is a wonderfully cheerful, happy, plucky, uncomplaining chap, the best of good company to himself and to every one else about him. I don't mind confessing that I fell completely in love with him in my month on the Isonzo and formed a very high opinion of his intelligence, endurance, and soldierly qualities; which I am proud to feel has been more than justified, after his temporary disaster on the Isonzo, by his splendid tenacity and determination on the Piave, the Brenta, and Monte Grappa.

He is content with the simplest and plainest of foods — bread, cheese, meat stew, onions, red wine — hard work all day and a hard couch at night, if he can only have a couple of hours in the sunset and the twilight to stretch himself and chat and joke, to strum upon his mandolin, to sing to its plaintive strains or dance to its lively ones. His pluck and cheerfulness, when wounded and suffering, are simply beyond praise. I have heard men shot through the chest or abdomen, or with both legs shattered, joke and laugh with the bearers, as they were being lifted out of the ambulance to be carried to the operating-table.

No army on the Western Front could show finer

examples of heroism and devotion. I saw the slopes on the Carso where, in the early months of the war, when they were almost destitute of heavy artillery, one volunteer party after another had rushed right up to the barbed-wire entanglements of the Austrian intrenchments, carrying tubes of high explosives which they *hurled into the wire by hand* — well knowing that none would return unwounded, and few alive — until a breach was cleared through which the columns behind could pour over their bodies and flood the enemy trenches.

No other army had so splendid a record and display of patient, tireless work actually accomplished, of superb automobile roads, carried to the very tops of the mountains, of bridges built, tunnels bored; of mountains pierced or their whole tops blown off by mines; to say nothing of heavy guns dragged up above the snow-line or mounted on giddy peaks where there was scarce footing for a chamois, and wonderful cable aerial railways swinging like spiders' webs from crag to crag or from the brink of the precipice to the valley below.

Really they were such a busy and industrious community that they struck me as having less leisure for mere entertainment and educational activities than almost any army that I visited. After a hard day's work to smoke and chat and lounge in the soft evening air seemed to be enjoyment enough for them;

while the officers were such courteous and obliging guides, such stanch and cordial comrades, such charming good company and good fellows that my eye lights up and my heart warms to this day at the very sight of an Italian uniform.

In all the French, and in many of the Italian, camps there were excellent coöperative stores, managed by committees appointed by the men themselves, which supplied tobacco, chocolate and other sweets, soap and toilet articles, stationery, smaller articles of wearing apparel, and the innumerable odds and ends required to supplement army supplies in a camp. Buying at wholesale and often in conjunction with the army contractor, these stores were able to supply an excellent quality of goods at very moderate prices. Just as an illustration, on several different occasions the officer who was acting as my guide and escort would make some excuse for going past the coöperative store, because he could buy some particular brand of cigarette or toilet article or pocket cutlery cheaper than he could in the regular shops in the towns at the Base or even in Paris. All profits made were returned to the soldiers.

XXIV

THE PULSE AND TEMPERATURE OF FRANCE

IT is as hard to fix any single test and index of the health and resisting power of a nation at war as of an individual. The numbers of a nation may be counted, the weight of a man taken on the scales, but this gives mere bulk, not quality. Whether the bulk be fat or muscle, chest or "corporation," "bay window," remains to be seen.

One can measure the bulge, or the lifting power, or the punch of the muscles of an athlete, or list the size and equipment of the army which a nation can call to its colors. But these are the mere cutting edge of the ploughshare; how it will drive its conquering way through the long stern furrow of war or fever depends upon the heart and circulation and vital resources behind it.

A nation at war is like a man fighting a fever, or, more aptly, like one who has had the valves of his heart damaged, so that its muscle has to work much harder to pump the same amount of blood over the body. At first everything is excitement and upset and block, half the normal activities thrown out of gear. Collapse seems imminent, but gradually a sort

of compromise is adjusted, some parts of the body learn to do with less blood, others to utilize more of it; "compensation," as we say in pompous technical terms, "is established," and a working balance reached which may be maintained for years and even decades.

Some cynic physician philosopher has declared that the best way to reach a good old age is to acquire some chronic disease and then take good care of it.

Nations have even greater, wider powers of "compensation" and adjustment than individuals because their vital organs and "parts" are interchangeable, and they never die. Moreover, paradoxical and even incredible as it may sound, there is ground for doubt whether war is as utterly abnormal a state for a nation as fever is for an individual. Certainly it is a process of which it has had an astonishing amount of experience, and which, if it had not been well able to "carry on," for long periods without vital damage, it would never have survived to the present day.

Indeed, though we speak most confidently and axiomatically of peace being the usual state and regular business of a nation, while war is its occasional and exceptional addiction and interlude, yet even this belief is not so firmly based as could be wished. For instance, careful study from this point of view of the last four hundred and fifty years of European history, from 1450 to 1900, by Dr. Frederic Adams Woods,

reveals the appalling fact that in the first century of that period war occupied *fifty-five per cent* of the time and in the last century *over thirty per cent*! In the whole four hundred and fifty years there have been only two periods, one of ten and the other of seventeen years, of complete and universal peace all over the Continent. So that while Europe has unquestionably made its greatest and most wonderful progress during the last century of comparative peace, it evidently takes a good deal of war to crush or "bleed white" a nation.

No more vivid and wonderful demonstration of the rallying powers of a nation under the strains and horrors of war has ever been furnished than that of heroic France to-day. For four years she has been the chief bulwark of democracy and free civilization against the invading flood of a new scientific savagery and feudalism, and yet her head is up, her eyes are bright, her fire undimmed and indomitable.

The visitor to France to-day, instead of being struck by the evidences of change and exhaustion or decline of bustle and activity, is surprised to find so little surface change in her streets, her markets, and her great centers of traffic. If it were not for the strong tinge of "horizon blue" in the busy crowds, the pitiful prevalence of black in the costumes of the women, and the dim lighting of the streets at night, one would have to shake one's self and recall the

historic facts to realize that one is really in a country which is desperately at war.

Part of this is due to the heroic endurance and lofty pride of the French nation, particularly of the women. But part to certain new and curious changes in the character of modern war, which even help to compensate somewhat for its abominations in other respects.

One of these is the strange fixity or "ossification" of the fighting-line, due to the trench system of warfare, so that railroad trains run right up to and into the zone of fire, almost up to the third-line trench every few miles, comparatively speaking, all along the Front. This makes "the war" quite accessible and convenient, so that soldiers from all over the southern and eastern parts of France can reach their billets on the Front within a day's ride or even a few hours from home, and can come back again on periods of leave or *permission* every three to six months.

This may look like a trivial thing in itself, but psychologically it helps greatly to reassure and to take off some of the worst edge of the dread and anxiety of wives and families. Instead of feeling, as in former wars, that their sons and husbands are going away hundreds of miles, almost under sentence of death, with no prospect of ever seeing them again until the war is over or they are sent back disabled for life, the families of the soldiers can at least buoy themselves up with the hope of seeing them back

again on *permission* safe and sound within three months.

And as with all the deadliness and fierce engines of destruction of modern war not more than five per cent of the combatants are either killed or seriously wounded or disabled by disease within a year, this hope of safe return is fulfilled in the vast majority of cases a number of times before they are even sufficiently severely wounded to be invalided home. This much more frequent opportunity of visits home from dear ones in the trenches, while, alas, it can do little to lighten the terrible blow when it does fall upon the five per cent, does much to relieve the tension of agonized dread and brooding anxiety of year-long periods of absence in the ninety-five per cent where no disaster occurs.

At all events, it does visibly and mercifully take off some of the agonized tension of grief and foreboding dread from the departure of a troop train, or of the farewell of a soldier to his family at the gates of a great railway station. He has come back before safe and well, why not again?

Incidentally, also, this constant and comparatively frequent interchange and communication between the Front and the home town helps to keep the appearance of the streets, particularly of the larger towns and main railroad centers, unexpectedly natural, by taking off the sense of a scarcity of young

men in the crowd. Indeed, this, in addition to the fact that only a certain percentage of the troops is actually at or near the Front, the remainder being held in reserve in training-camps scattered all through the country, and incessantly transferred backward and forward from active to reserve duty, makes an almost constant flow and thronging of men in uniform through all but the smaller towns and country villages, and even in a great many of them. So that there is much more going on in the way of travel, trade, business, and even amusement and society of a sort, over all the central and eastern half of France than one would have expected from conditions in previous wars.

A second peculiarity of modern war, which has helped France to adjust herself and maintain a working balance even under the terrible strain which she has suffered, is that it is so emphatically and overwhelmingly a war of machinery and big guns. Its motto is a paraphrase of Napoleon's "Audacity," "Ammunition, and again ammunition, and always ammunition!" or "Shells to save life," in Lloyd George's paradoxical phrase! For the army that has most guns and ammunition loses fewest soldiers in an offensive.

A war of munitions and railroads, of telephone and telegraph and electrical equipment of every imaginable sort, of huge howitzers mounted like observatory

telescopes, moved by clockwork and aimed with surveyor's transit, of airplanes and motor lorries and motor ambulances by the hundred thousand. This enormous and incessant demand has stimulated manufacturing and production of all sorts so tremendously, new factories springing up like mushrooms everywhere to meet it, that the whole civilian population at home, the women and children of the soldiers, and the men too old or physically unfit for military service, instead of being thrown out of work and left to starve, have had abundant employment at double and even treble the wages they had ever dreamed of before.

So great has been the rise in wages, so keen the demand for labor, that many a soldier's wife or daughter is actually making more money at home in the war factory than the head of the family was able to earn in time of peace. Wages of all sorts on an average have doubled, and in not a few fields of industry trebled, since the outbreak of the war. And it is one of the axioms of military experts that a nation is physically able to put no more than one tenth of its total population in the field for active service, or one half of its men of military age which means about one third of all males of working ages. This means that most of the other two thirds and all the women of the community have been earning higher wages than they ever did in their lives before.

Wages have actually kept pace with the higher cost of food, and as many families have now two and three wage-earners in the place of one, the net result has been, in the almost unanimous opinion of those interested and expert in labor conditions in France, that the great mass of her people are better fed, better clothed, and are working shorter hours and under more healthful conditions than they were before the war.

And this was the distinct impression, for whatever it may be worth, which I gained from my own personal observation. I spent nearly six months in France last year, from spring till late autumn of 1917, making numerous journeys both to and from the Front and through the interior, covering some thirty or forty different regions and towns, from country districts up to great cities, and found surprisingly little sign of unemployment, of destitution, or of visible underfeeding or food scarcity.

I was particularly careful to visit the industrial sections of the cities and towns, the slums if any, and the poorer and outlying streets of the country towns and villages, to watch the crowds at the factory gates, on the streets, in the parks in the evenings and on holidays, and especially to keep a keen eye upon that best and most graphic index of the vital condition of a community, the faces of the children.

Much to my relief and gratification, after the pessi-

mistic and discouraging reports which I had heard before I visited France, I found the overwhelming majority of the quaintly charming and intelligent little future citizens of the Republic playing hard and happily, with bright eyes, fresh color, and sturdy, bare, brown legs. They scurried eagerly about, shouting at the tops of their voices, and making wonderful gesture-play as merrily as if they had n't a care in the world, and were as well nourished and vigorous, as free from visible defect or disease, as the groups which can be seen on our own streets.

I was told by my colleagues, both French and American, who were engaged in work among the children and in children's hospitals, that the high value placed by the war on children and child life, had so stimulated the activities of the many public-spirited organizations for child welfare, both French and Allied, such as the English Red Cross and many other equally devoted but smaller organizations, that the actual infant mortality-rate or death-rate among children under one year of age, instead of increasing, had been brought down in France to one of the lowest levels in her history!

Incidentally, a like unexpected and gratifying result has been brought about in many districts in Belgium by the devoted efforts of Belgian philanthropists and physicians backed by our American Belgian Relief Commission. And, of course, Germany,

who did not put one little finger to the work, is characteristically claiming the entire result as one of the visible blessings of Prussian rule and the sway of *Kultur*.

To put it roughly, a considerable share of the huge sum voted by the French Government for war expenses has gone directly back into the pockets and the lives of the working-class majority of her population in the form of high wages, and while this will have to be paid for some day, yet for the present it greatly helps to redress the balance of industry and economic prosperity so rudely shaken by war.

Part of it is an actual drain upon the total reserves of the country in the sense of a new draft upon the strength and vital resources of its women, who have so nobly and splendidly risen to and met the emergency. But not all of it, by any means, because the thing which has made it possible has been the introduction of the most modern labor-saving machinery on a tremendous scale, as well as modern efficiency methods of operation.

The motor-power for this machinery is being largely and increasingly drawn from the hitherto unutilized natural water-power of the country. A most interesting and striking shift of the great manufacturing industries of France has been made from the northeastern regions, where the coal is, down to the plains and valleys of the south and southeast, near

the mountains where the water-power is. Which also has the advantage of helping to offset the German occupation of some of the richest coal mines and of placing the industries and their swarms of workers at a safer distance from bomb-dropping raids and other hostile interference. France has not lost for a moment either her splendid courage or her wonderful economic shrewdness and foresight in this terrible war. This utilization of her water-power will be a permanent addition to her national assets after the war. And the same is true in even greater measure in the case of Italy.

It is not too much to say that most of this superb contribution of war work by the women of France has been made by the aid of labor-saving machinery, under such greatly improved industrial working conditions, with shorter hours and higher wages, that it has been no greater drain upon their resources and their health than the household or small shop or farm occupations, which they followed before the war. Indeed, it has actually been found, in a number of munitions works studied, in both France and England, that the women were able to feed themselves so much better on high wages, to give themselves so much more regular rest, and to afford healthful recreation and amusements and broader interests of life, that their health, instead of deteriorating, has actually improved under the work. In most

Government-controlled plants they are carefully supervised and guided by women physicians and other welfare workers, so that they know how to protect themselves and to take care of their health better than ever before.

As for the much-talked-of shortages of food and even "famines," these actually for the most part are confined to certain special articles of food, such as sugar, butter, milk, white flour, pork, etc. Many of these, even, are only temporary and local in nature, and there are substitutes to be had except in the case of sugar. Taking it by and large — again speaking from the perhaps limited point of view of my own experience — the only serious obstacle to procuring an adequate supply of nourishing food in most parts of France that I visited was the price. And even that barrier became less formidable as one went down into the smaller towns and country districts.

There was no white bread, but plenty of brown war bread; in fact, less restriction was placed upon the use of bread in the restaurants and cafés, and so far as one could judge in private houses, than in England. There was barely enough sugar for the coffee, but plenty of fresh fruit and vegetables, and a limited but adequate supply of fresh meat and ham. Prices in Paris and the other great cities were high, but no higher on an average than in New York or Boston, and the main difficulty was skirmishing

about perpetually and exercising one's ingenuity over the bills of fare to find substitutes that were "just as good," on the two meatless days in the week and the two on which desserts, puddings, cakes, etc., containing much sugar could not be served.

To take the rough test of restaurant prices all through the summer and up to the last week in October, 1917, when I left France, one could get in the medium-sized and smaller towns and, what furnishes a good average sample, in the dining-cars on the railroads, a good satisfying meal — soup or macaroni, fish or entrée, meat, potatoes, salad, cheese, and fruit, for from 65 cents to \$1.00. Comfortable accommodations and excellent meals could be got in country-town hotels, especially in the South and West or toward the Swiss border for from \$1.75 to \$2.50 a day. In the villages and country districts there was a good supply of food, though somewhat coarse and monotonous according to our American standards. Although there had been a distinct falling-off in the size of the principal crops, yet the smaller crops were sold at much higher prices and the farmers felt comparatively prosperous. Besides, it must be frankly admitted that no peasant or farmer anywhere in any country is going to run himself dangerously short of the food which he has raised himself in order to supply city people.

The wheat crop of France, for instance, has fallen

off more than a third in three years, but the wages of the great mass of working-people have been so good that so long as a reasonable supply from abroad was procurable, they have been able to feed themselves well. The only fear was lest this supply should be cut down by the urgent need of ships for transporting our American Army to France, but our splendid shipbuilding programmes have relieved that difficulty already.

XXV

MOUNTAINS AND MEDICINE: ITALY'S WAR ON DISEASE

ROME was almost as famous for her aqueducts, her baths, and her sewers as for her legions and her laws. So when her descendants and representatives of to-day make war, they proceed, on ancestral grounds, to attack its sanitary and surgical problems as thoroughly, as patiently, and as effectively as they attack its engineering and its military ones. For the offensive of 1917 toward Trieste, which I saw, they had in readiness within twenty miles of the Front not only hundreds of thousands of men, thousands of guns, and millions of shells, but six hundred hospitals with one hundred thousand beds, and doctors and nurses and ambulances by the thousand.

The "theater of war" is no mere figure of speech in the Italian campaign, for the whole drama is set in a huge natural amphitheater walled in by the semi-circular sweep of mountains, with dusty blue mists for drop curtains, lifted from time to time to show battle-fields literally hung up in the air, draped upon the shoulders of the mountains for a world to see.

On a clear day you can see the shells bursting on the ridge-crests around Monte Nero, silhouetted

against the violet sky, twenty miles away. And the mountains dominate the whole movement.

It is a war of mountains, for mountains, between mountains — I had almost said by mountains; for no sooner is one mountain captured than it is organized and armed into a fortress for an attack upon the next mountain facing it across the deep valley. Everything has to learn to climb and half-dig itself in, half-hang on by its toe-nails and eyelids on some narrow shelf on the mountain-side: not merely men and guns, horses, mules, Field-Hospitals, Dressing-Stations, motor-dynamos, but huge water-casks and boats, great whale boats and barges, to be used for the pontoon bridges across the fierce little river at the bottom of the gorge below the next mountain.

I have seen long black bateaux, capable of holding forty men, hauled up the "safe and sane" side of the mountain, where there are fine roads, on huge motor lorries or tractors, to be lowered by cable down the "unhealthy" side over rocks, cliffs, and trees — for roads don't grow well under shell-fire — in the darkest and quietest hours of the night — if there are any for the star-shells and Verey lights.

Most of the plagues of the soldier are his old familiar home diseases in more vicious form. Typhoid, pneumonia, tuberculosis, dysentery, heart disease, kidney disease, these are the maladies which account for the

vast majority of deaths in camp and barrack, just as in peaceful civil life.

But sometimes the fierce earthquake of war shakes and hurls us back to the primitive, in both morals and maladies, and raises unexpected ghosts of strange and half-forgotten ancient diseases to vex us again. Some, fortunately, are too dead to rise again in any earthquake resurrection, however rending — "Black Death," smallpox, the sweating sickness, these, we believe, can never raise their heads again in any civilized and sanitary community; though we boast with our fingers crossed, and our knuckles rapping on ligno-cellulose substance.

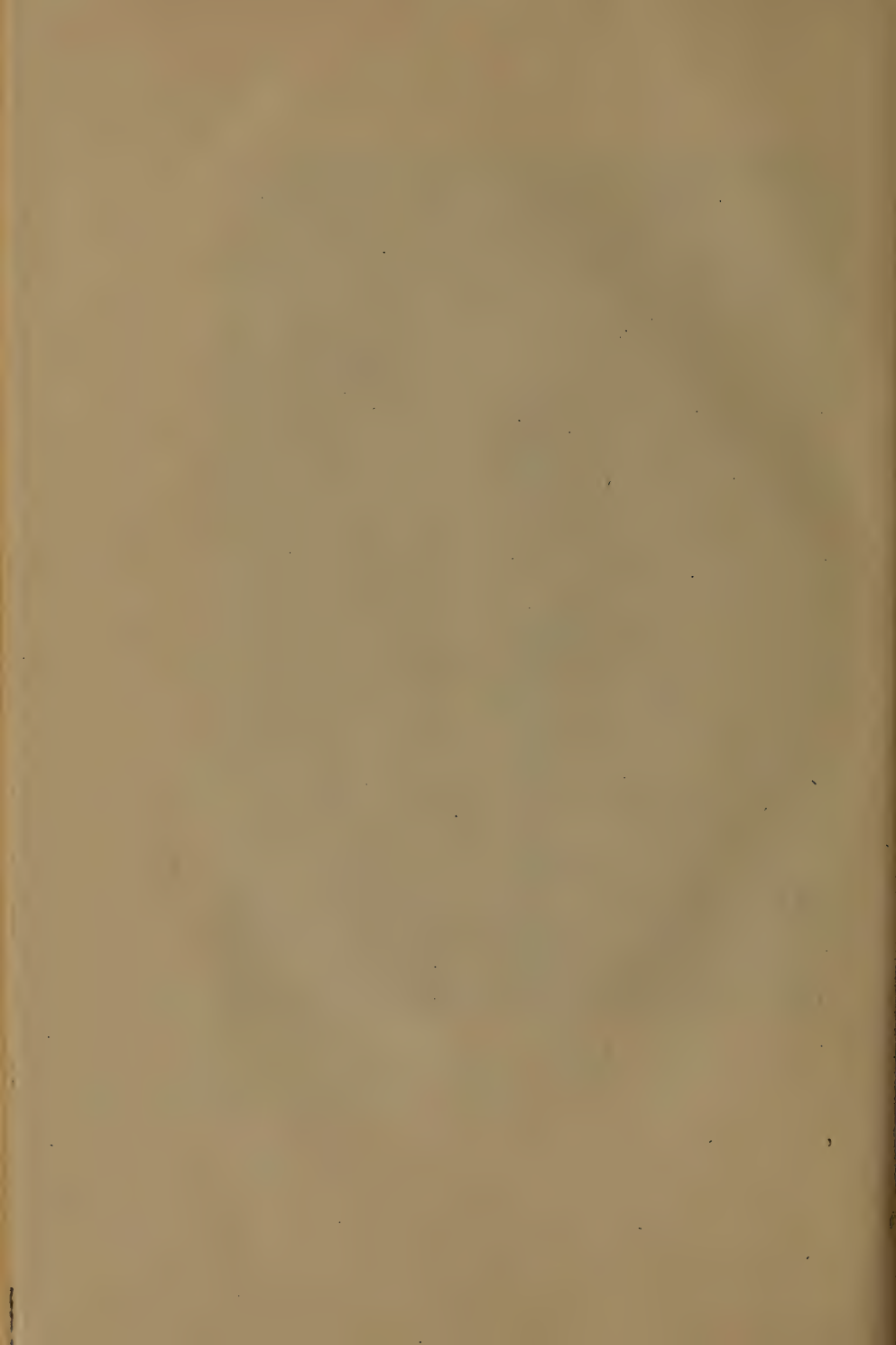
But a few of the historic plagues are not buried so deeply nor so dead, and two of them have come to life again in this war, typhus and cholera, both from the regions of the Unwashed East; both brought in by Austrian prisoners, typhus into Serbia, cholera into Italy.

The typhus epidemic ran like wildfire through the war-ravaged and half-famished Serbia, until it was tackled, and not merely checked but completely stamped out, by the splendid and masterly work of an Anglo-American Commission.

Italy's cholera epidemic faced her suddenly in the first year of the war, in most menacing proportions. The disease came in gradually and insidiously in the form of scattered cholera-carriers among the first



SERBIAN WOUNDED COMING FROM THE MOUNTAINS



thousands of Austrian prisoners. There were no open cases, nothing, in fact, to arouse any suspicion whatever until these prisoner carriers had been scattered out through a number of prison camps and had infected the water-supply of some of the Italian troops.

Then, with the approach of the hot weather, like a forest fire that had run underground, the disease burst out in full vigor, in a dozen different centers at once, and within a few weeks the sanitarians had seven or eight thousand cases on their hands.

But not a moment was lost in attacking the outbreak. The Sanita of the Italian Army fell upon it at once, horse, foot, and dragoons, in a most workmanlike fashion. All known cases were isolated in comfortable hospital camps, given the best of treatment and care, and their discharges rigidly sterilized so as to prevent any further spread of the disease from them.

How intelligent and effective was the treatment given them may be judged by the fact that, while the ordinary death-rate from cholera is from thirty to fifty per cent, the total losses among these cases were barely twenty per cent, including a considerable number of the earliest cases, who were almost at death's door before the disease was properly recognized. In fact, the death-rate in the first few weeks of the disease was something like forty per cent,

showing that it was no mild or trifling type of the dread infection.

Then all who had come in contact or were suspected of having come in contact with the cases, or had drunk of presumably infected water, were given the cholera vaccine, which, though not so certain or so perfect as the smallpox and the typhoid vaccine, was found to give a very helpful degree of protection. All water-supplies for the troops and prisoners were, of course, chlorinated at once, so as to short-circuit the spread of the infection along that wire.

Then the disinfection brigade got busy with their big tank pumps on wheels, like old-fashioned fire engines, and hosed and sluiced down every infected building or hut or hospital with floods of permanganate and bichloride solution. In some cases they even went into the trenches, and flushed and flooded and sprayed the walls and the floor-bottoms, and the dug-outs and underground shelters. The germs must have thought it was Deluge No. 2, only a bichloride Flood this time.

Within a few weeks the new cases began to tail off rapidly, and although the cholera still smouldered along slowly, with a few scattered cases here and there until the approach of the cool weather sent it into winter quarters after its usual fashion, yet its back had been broken by the first rush, so that it

was held down to a total of barely ten thousand cases with two thousand deaths, only a couple of thousand beyond the first month's outburst.

Everybody, of course, was on the *qui vive* for a new crop of the disease in the spring, but so thoroughly had the work of stamping out been done, that out of over a million soldiers and a hundred thousand prisoners on the Isonzo Front, only about twelve hundred cases developed with some two hundred deaths, and when I was there in August in the next cholera season, there had scarcely been a single case.

But the Sanita takes no risks with its future prisoners; they are made to walk the bacteriological plank in the most thorough-going fashion. Just as soon as they are brought down from the mountains into the first-line prison camps, which are well isolated from the barracks of the troops, they are first stripped and examined for vaccination scars against smallpox, and if they cannot show a clear-marked, recent scar, they are promptly vaccinated. As soon as they have recovered from this, they are given an injection of the anti-typhoid vaccine, then they and their clothing are thoroughly "unloused," in steam sterilizers and hot baths.

Finally, before they are allowed to go on to the permanent camps or working-gangs in the interior of the country, the feces of every one of them are bacteriologically examined for the cholera germ, to be sure

that there are no carriers among them. This sounds rather tempestuous for the poor prisoners, but as they are well fed, comfortably housed, kindly treated, and delighted to get out of the trenches, they bear it nobly without murmur, apparently in the philosophic hope that some future good may come out of all this tribulation.

Nor are they disappointed, for the net result of what twenty years ago would have been viewed as mere doctors' fussiness and tomfoolery, is that in all her prison camps, in over two and a half years of war, Italy has scarcely had a single serious epidemic or outbreak of troublesome disease!

I visited several of these disinfection prison camps, and found them on well-drained ground, usually near the banks of some stream and surrounded with a high double fence of barbed wire. Along one side were rows of plain, comfortable, rough board bunk-houses, a long dining-shed and mess kitchen, in one of which I saw the prisoners at dinner, with apparently exactly the same food as the Italian soldiers were receiving in their messes. There was a good supply of pure drinking-water, and in front of the bunk-houses were one or more great cement troughs, almost tanks in size, forty or fifty feet long, eight feet wide and four deep, with a continuous flow of water through them from a standpipe. They had ledges wide enough to hold soap, towels, and small articles

of clothing, and were used by the prisoners both for their own ablutions and for washing their clothing.

On the other side of the ground was a small hospital, plain and rough, but clean and well equipped, with good bedding and blankets, and at the end near the entrance were the quarters of the commandant and of the guards. A wide strip of the ground along the hospital side of the camp was turned into garden, and planted, not merely with vegetables, but also with flowers, both to afford occupation for the prisoners and to supply them with fresh vegetables.

There were good latrines of the cement tank type, and everything was spotlessly clean, not an offensive odor or a sign of garbage or refuse, or a fly anywhere.

The "unlousing" equipment is a most effective and interesting one. A long, shed-like, wooden building divided into a roomy undressing-room at one end, a dressing-room at the other, and between the two on the one side a huge steam sterilizer and on the other a large bathroom with hot-water douches pouring from overhead pipes. The prisoners undress in the first room, their clothing is put into wide-meshed net bags and promptly passed into the steam sterilizer, and they themselves march into the bathroom. Here they stand under the douches, and lather themselves thoroughly with soap, while an orderly at one end of the room stands with a flexible hose, which he turns on their chests and backs as they rotate

slowly before him for inspection, to make good any oversights in their toilet.

Then they go on into the dressing-room, where they meet their clothes which have already arrived from the steam sterilizer, the two are reunited and out they go clean and cootie-free, safe for a fortnight at least. The steam is superheated to such a temperature that all that is necessary is to open the bundle of clothing, give each garment a shake and it is dry in a second.

The heads of the soldiers are gone over in most domestic fashion with the familiar fine-tooth comb of unblest childhood memory, and then they are given boxes of fragrant or rather loud-smelling salve containing insecticides to rub into their armpits.

A similar equipment is a regular institution in every camp of a battalion or more all along the whole Western Front and has enormously reduced the Fifth Plague of Egypt.

Incidentally, it may be noted that this is in somewhat striking contrast with Germany's method of handling outbreaks of typhus in her prison camps. This has the merit of being of a charming simplicity and inexpensiveness, and consists in promptly withdrawing the prison doctors and hospital attendants and all other German officials from the camp, posting a double guard round the barbed-wire stockade, throwing over supplies of food each day, and letting

the disease run its course and burn itself out. It saves disinfectants and all other expense, and has in addition the advantage, as one of the prison commandants explained with engaging frankness, of leaving "fewer of these verflüchte Engländer to trouble us."

My visit to the Italian Front was one of the most interesting and delightful features of my entire trip. It began with the inspection of some eight or nine of the great Base Hospitals in Rome, which were superbly equipped and managed. Two or three were ordinary military surgical hospitals for the wounded, but as Rome is a considerable distance back from the firing-line, the major part of its hospitals were utilized for medical diseases and chronic conditions and for reconstruction purposes, while the wounded were mainly sent to the great hospitals nearer the Front in Milan, Turin, Padua, Bologna, and Florence.

One of the most interesting was an establishment for tuberculous soldiers in the Villa Celio, on a hill-top, with a superb view off over the Campagna and the distant hills. Here were received the men who had broken down, presumably from tuberculosis, or who had failed to pass the Draft Board for the same cause. They were given a thorough and careful X-ray examination, the Pirquet skin test for tuberculosis, their sputum was examined under the microscope, and they were held under observation for

from one to three weeks, meanwhile sleeping on great galleries in the open air, liberally and abundantly fed, and given the best and most skilled of medical treatment.

Then those who were found not to be tuberculous, who were quite a considerable moiety of the number, were sent back to their regiments or to such work as they were fitted for behind the lines. Those that were in an early stage of the disease were sent to sanatoria which the Italian Government had built since the war, up in the mountains, while those for whom the outlook was less hopeful, or whose disease was complicated by wounds or other morbid conditions, were sent to hospitals arranged for their reception, each man being sent to the establishment nearest to his home and family.

The system is admirably worked out with the assistance of the Italian Red Cross. Soldiers found tuberculous are given pensions for three years and support for their families meanwhile. The suspects among the repatriated prisoners of war are sent on in the same train to the seaside sanatorium at Nervi, which has accommodations for 1200. The suspects from the Army are sent to the sanatorium near Florence. Both are new and well-equipped sanatoria, beautifully located. The Red Cross has two trains for the tuberculous, four climatic sanatoria with a total of 900 beds, and three institutions for the moderately

severe cases, with 640 beds. The Army has seven regional sanatoria, with a total of 3808 beds, eleven institutions for the advanced cases, besides the Nervi and Florence sanatoria, and centers in each army corps for prolonged observation and diagnosis by the most approved methods. Some corps have more than one.

When I was at the Villa Celio, about a year and a half after Italy entered the war, there had been over thirty thousand sputum examinations made and about half that number of X-ray studies. And this is only a sample of the thoroughness and efficiency of the work done by the Medical Department of the Italian Army. At the great General Medical Hospital (Ospedale Contumaciaale) at Udine, only thirty miles behind the Front, I was shown records of some fifty thousand laboratory tests and examinations made within the year.

Another of the hospitals in Rome, on the Lateran Hill, close to the famous Sacred Staircase (Scala Santa), which the faithful ascend upon their knees, had two large wards devoted exclusively to the wounds of the face and jaws. Here the very best and most modern methods of both dental and surgical repair, described in an earlier chapter, were carried out by a competent staff, and it was a matter of patriotic pride to find that two of the most enthusiastic and competent dental surgeons, who were work-

ing these miracles of repair and saving the poor wounded from a lifelong disfigurement worse than death, were graduates of American schools.

At Udine I further found a complete hospital of two hundred beds situated in beautiful grounds and elaborately equipped, devoted to this same making of new faces for old.

I also visited two admirable hospital schools for the double purpose of making and fitting the best and most modern type of artificial limbs for soldiers who had lost a leg or an arm, and at the same time teaching them, during the period that they were being trained to wear their new appliances, how to adapt themselves to their old trades, or to learn new ones better suited to their disabled condition. One of these was most beautifully and delightfully housed in a wing of the great Royal Palace itself, the Quirinal.

The very throne-room of the Palace, which had been the bed-chamber of a mediæval Pope, was turned into a ward and the Royal Chapel into a store-room for bandages and linen.

Another beautiful villa, with acres of superb gardens and grounds, on the slope of the great Janiculan Hill, had been turned into a delightful hospital for cases of shell-shock and mental strain. If the view from the front piazza, including in its sweep almost the whole panorama of the Eternal City, as it lay

in the sunset light on the summer evening when I visited it, would not start a shell-shock in the direction of recovery, I don't know anything in the world that would.

Most of the Italian hospitals were in tall, high-ceilinged rooms, with abundance of great windows, and bare, white or lightly tinted walls, such as are customary in hot climates and through Latin Europe generally. This was true both in the buildings which had been constructed especially for hospitals and those which had been simply taken over and adapted to the purpose for the duration of the war. Every imaginable type of building had been pressed into the service of healing in this way, convents, colleges, palaces, schools, villas, monasteries, and even, in emergency, churches and chapels, which were gladly yielded up for this work of mercy and of pity. A greater variety of architecture and of forms and sizes of wards could hardly be imagined, but they all had one feature in common, they were beautifully light and spotlessly clean. If by any chance they were n't when they were first taken over, they became so before the Sanita, or Sanitary Department of the Italian Army, got through with them.

If the walls and ceilings were not absolutely immaculate, they were hosed down with bichloride solution and then given a coat of whitewash or kalsomine in some delicate tint. In many of them, with

that natural and instinctive taste which Italians of all grades of social rank possess, a light band of stencil work in attractive colors was run round the walls or over each of the great windows, and the effect was extremely pleasing. Most of the floors were of stone or concrete, so that it was easy to keep them clean, and if in poor repair, to give them a fresh surface coat of cement. There were no rugs or carpets on the floor, except sometimes a single strip down the aisle, and no pictures or elaborate hangings about the windows to catch dust, and no corners in which dirt could lurk undetected, and the net result was that the whole group of them impressed one as among the most spotless and beautifully clean wards and buildings which it would be possible to find anywhere.

The kitchens and sculleries and outhouses and rear premises were kept equally immaculate, every scrap of garbage, every dustpan or shovelful of dirt, was sprinkled with kerosene, placed in a primitive brick or stone furnace, and burned. So that much to my surprise and delight, in the very worst month of the year in that scorching hot climate, August, I found practically no flies in the wards or kitchens and outbuildings, although the windows were for the most part unscreened.

What was more unexpected still, this miracle of flylessness was achieved, not only in the great Base Hospitals in the cities and towns, but even in most

of the Ospedali da Campo and Ospedaletti da Campo in the little villages and camps just behind the Front. The transport stables and artillery and cavalry lines were kept well off by themselves, and every scrap of manure either piled up and sprinkled with kerosene and burnt, or carted away by the thrifty and enterprising peasantry and spread at once on the land.

But the vigilance and passion for cleanliness of the Sanita did not end even here. They were thoroughly awake to the dangers and unhealthfulness of dust as well as of flies, and actually had the superb audacity to attack this intolerable nuisance of an army in the field and endeavor, as nearly as possible, to wipe it out, and that in a climate resembling that of our own Arizona or Southern California.

And they were astonishingly successful. They at first tackled the chief and most constant source of dust in any climate, the roads. The world is ringing with the triumph of the Italian engineers in road-building, mountain-piercing, bridge-making, etc., and the superb system of beautifully built and kept roads, which covered the Venetian and Friulian plains, to serve as the main arteries of the army fighting in the mountains that bounded them on the north and east, was not the least of their achievements. They were superbly laid and graded, with a surface as hard and level as a billiard table; in fact, I have never seen anywhere in the finest park boulevards or famous

city driveways anything finer in the form of road surfaces. But they were built chiefly of limestone, and with the incessant stream and rumble of traffic that poured over them, to say nothing of the tramp of hundreds of thousands of marching feet backward and forward along them day and night, would mean dust of a flour-like fineness and penetration, in clouds and clouds.

But the ingenuity of the Italians was not baffled for a moment. The country is a rich alluvial deposit, one continuous checker-board of vineyards and orchards and cornfields, but thirsty in summer-time and has to be irrigated through ditches with water drawn from the mountain streams. Nothing was easier than to have a couple of these irrigating ditches running one along each side of every road; then an army of old men and boys is drawn up in scattered ranks on either side of the highway and set to work, first of all, sweeping all dust and dried horse manure and other dirt which is deposited upon the hard white surface of the road, shoveling it into wheelbarrows and wheeling it out on to the soil of the vineyards and cornfields on either side.

As fast as this is done by one division, another division deploys into action armed with curious long-handled wooden scoops or hollowed shovels, with which they dextrously scoop up the water out of the irrigating ditch and send it flying across the

clean white surface of the road. The bulk of the sweeping is done at night when the traffic is lighter, but this primitive scoop sprinkling is kept up all day long. Everywhere that you drive you can see the little jets of spray shooting up from both sides of the road. The system works like a charm, how perfectly may be gathered from the fact that during the three August weeks which I spent in motoring up and down the Front and backward and forward along these roads from Headquarters and the Bases, I never once found it necessary to wear a dustcoat, let alone goggles or a veil, and only upon one or two occasions was there enough dust in the air to attract attention.

The difference which this triumph over road dust made to both the comfort and the health of the marching columns, to say nothing of the poor horses and mules, can easily be imagined but hardly overestimated. It was actually found to diminish markedly the amount of catarrh and other irritations of the nose, throat, and eyes of the soldiers, and to keep their feet in very much better condition, less likely to chafe and blister on the march, while if chafes or blisters did form, they healed more rapidly and kindly than when exposed to the often infected and poisonous dust of the ordinary roads. It is only fair to add that there was another purpose also for this painstaking campaign against dust, and that was that the majority of these roads were not only in

plain view of the Austrian observation posts up in the mountains, which overlooked them, but exposed to shell-fire from the Austrian guns. Hence it was of the greatest importance that the Austrian observers should not be able to detect readily extensive troop movements by the columns of dust sent up, and also that the roads themselves should not advertise too constantly and obtrusively their own position, so as to give their range to enemy gunners. So that the Sanita had the weighty and influential backing of the General Staff and of the line in their brilliant attack upon the dust nuisance. But such was the addition to the marching power and comfort of the troops and the cleanliness and freedom from dust and grit of the guns and other elaborate machinery of war transported over these roads, that the line officers frankly admitted that the work was well worth all its cost, even apart from its value in concealing the movements of troops or of supply-trains from the enemy.

Similar precautions of constant sprinkling, combined with the burning or burying of all sweepings and camp waste, were carried out in most of the camps in the plains, to the great advantage and comfort both of the troops and of the wounded in the hospitals about.

The same precautions were taken with the batteries and gun emplacements, and I was considerably

amused, on visiting some of the English heavy artillery posts on the edges of the Corso, to hear the men grumbling about the fag and nuisance of perpetually hauling water in carts and casks from a river or pool a couple of miles away, in order to keep the ground around the belching monsters well wet down, so that the tremendous shock of their recoil would not send the telltale cloud up into the air to furnish a clue to the Austrian batteries above them. One somehow had never thought of a water cart as part of the necessary equipment of a nine-inch gun.

A more ideally beautiful theater of war could hardly be imagined than the broad green Venetian plain, bounded on the left by the crescentic rampart of the Julian Alps sweeping down to Trieste and the Gulf in front, and by the violet blue waters of the Adriatic on the right. The plain was intersected every three or four miles by the shallow valleys of swift, sparkling, mountain streams, which in the summer-time sank into the earth before they reached the sea, like the rivers of Southern California, and dotted all over with scores of little gray-walled villages and venerable towns, each with its tall white church-tower, half spire, half watch-tower against Moorish and Turkish pirates. Every one of these little villages was swarming with troops and ringed about with camps. And every one had furnished from two to five or six high-vaulted, white-walled

rooms for use as hospitals. The result was some most picturesque and striking contrasts. In one village I saw wounded Arditi and bandaged Bersaglieri lying in cots with their heads just under the gilded frame of a magnificent painting valued at twenty thousand dollars, with the rest of the equipment on the walls to match. This was in the villa of one of the Italian nobility, and it had other advantages as a hospital besides its beautiful pictures and magnificent furniture. The wife of the nobleman happened to be an Austrian princess and as a consequence, although all the villages and camps round about were scourged time and again by the Austrian fire, not a single shell ever fell upon this villa or in the little village clustered round the foot of the hill on which it stood. German and Austrian gunners *may* not intentionally shell hospitals, but they certainly *can* intentionally miss them when they want to.

Another romantic illustration of their powers of sparing certain buildings and regions was furnished on this same Italian Front, not twenty miles away from this hospital villa. Right on the crest of one of the highest ridges, which the Italian troops had wrested from the Austrians after furious fighting, and looking directly down upon the valley of the Isonzo where the armies were locked in mortal combat all summer long, was a little memorial chapel known as Santa Maria Zan. Every village and every church,

within five miles of it on either side and behind, had been battered into a mass of ruins; but its slender tower still rose toward the sky untouched, with not even a slate missing from its roof. The reason given for its singular immunity was that one of the favorite mistresses of the earlier and happier days of the Emperor Franz Josef was buried there. And as her tomb was plain to be seen just to the side of the altar and no other conceivable reason could be imagined for its escape, the explanation was at least highly probable.

I found another group of wounded soldiers lying in comfortable white cots in the dim religious light of stained-glass windows in a beautiful old church, or rather chapel of a monastery. At the other end of the scale, one of the busiest war hospitals which I visited was in an abandoned railway tunnel, drilled through the wall of the cliff-sided gorge of the Isonzo, another was in the entrance to an abandoned mine in the side of Monte Vodice, but in all of them alike, the wounded had had the best of attention and were resting as comfortably as their wounds would permit.

Two of the most picturesque hospitals that I saw on the Isonzo Front were in great, roomy, old-fashioned barns and granaries, with the huge roof beams and the under side of the tiles for their only ceiling. But these again had been thoroughly house-cleaned and whitewashed from floor to roof-peak by

the Sanita, and in one of them the wounded thought they were in clover and gave themselves great airs of superiority, because they were in the hands of the English Red Cross and waited upon by trained women nurses.

The most striking one of the whole series was the great riding-school of a big cavalry barracks, which had been converted into a single oval ward over six hundred feet long and with eleven hundred cots arranged in orderly rows upon its floor. As it was over sixty feet high in the center, its spotless white arching roof and delicately tinted walls, with its brilliant light, made it look like a literal temple of light and healing, though it must have been a fearful business to try and keep it warm in winter-time.

One new and interesting feature which the character of the country fought over has brought about is the great variety of means for the transportation of the wounded. First and far most frequent of all come the great motor ambulances, many of them of their own splendid Italian makes — Fiats, Lancias, and the like. Everywhere that the superb, boulevard-wide, billiard-table-level, military roads of the Italian engineers go — and they go pretty nearly everywhere — these rubber-tired, one-car hospital trains *de luxe* roll up to the Dressing-Stations and roll down again with the wounded in comfort and safety and speed. Just as an illustration of what their engineers

can do, I rode in a big Army limousine over a splendid road, with a surface like a floor, climbing in great sweeps and spirals right up to within a few hundred yards of the front-line trenches along the crest of Monte Vodice, over three thousand feet above the waters of the Isonzo, *within three weeks of the day that it had been captured from the Austrians!*

The only drawback to travel on these magnificent roads is that their inner side is a perpendicular wall of rock, their outer a sheer drop of hundreds of feet into the valley below, and your motor, being the lighter and more mobile vehicle, has to take the outer edge and give the wall to the ammunition wagons and motor "camions." And there is no parapet, not even a hand-rail, if —!

But then, as one of Mr. Shaw's topsy-turvy Cockney heroes remarks: "Hif you wunst begins to think — then good-bye 'appiness!" So you don't, but just sweep blissfully onward through the gap between the drop and the dynamite.

Next after the lordly Fiats come the old-fashioned wooden-wheeled, horse- or mule-drawn ambulances which, though with jolts and joggles incarnate, can scramble up steep-sided gullies or over rocky ledges and boulder-strewn mountain fords, where the rubber shoe of the motor could scarce dare a foothold. Except for short distances in rough and difficult country they are now chiefly used for the transportation of

the walking wounded, carry-all fashion, or for distributing the less seriously injured from the great Collecting-Stations a mile or so behind the Front to the near-by field and village hospitals, where the roads are comparatively level. I visited one of these Collecting-Stations about five o'clock in the afternoon, which had handled fourteen hundred wounded since daybreak that morning, and they were still pouring in.

Then come curious country carts drawn by sure-footed little mountain ponies or donkeys, curious to look upon and jolty to ride in, but capable of twisting their devious way up or down almost any mountain-side. And for the still more difficult places were litters, or long-shafted stretchers slung between two furry-eared donkeys or a couple of shaggy ponies; and last of all, of course, the old reliable and absolutely indispensable hand-stretcher, carried between two bearers, or in difficult places lifted high on the shoulders of four.

But the most unique and effective means of bringing down the wounded in high mountain fighting was the miniature cable-railway, or "teleferica," one of which was in full swing just behind the busy Collecting-Station bringing down the wounded from the tops of Monte Kuk a mile and a half away across the valley.

These wonderful little air-line trolleys, whose glit-



TRANSPORTATION OF WOUNDED BY TROLLEY IN THE
ITALIAN MOUNTAINS

tering cables of woven and twisted steel festoon all the mountain chains of the Italian Front, like a giant spider's web, loop peak to peak, and mountain-side to mountain-side across the gulf between, like the flight of a bird, or leap from the bare brink of the precipice down to the green valley below in one swoop and up to the glaciers above in another.

They did not originate in this war, any more than most of the other agencies which it employs, but have been in use for years in mining operations in mountainous regions, particularly in the South American Andes. And as the Italians are extensively interested in many enterprises in South America, particularly in the Argentine, their engineers brought back with them the idea of the overhead cable trolley and proceeded to adapt it for military purposes. It has proved so extraordinarily useful, in such an infinite variety of ways, that it would be really difficult to conceive what this war would be like in the high mountains without it. It plays as important a part among the peaks and mountain valleys as the motor does in the plains below.

In principle and construction it is simplicity itself, just a double line of swaying steel cable from half a mile to a mile and a half long stretched up the side of a mountain, across a valley, or in relays down the whole length of it, with little basket-cars slung on it on a deep-grooved trolley wheel and drawn

by a smaller and lighter cable wound over a rolling drum.

The passengers, food, ammunition, or supplies are placed in the little basket-car of perforated sheet steel and sent sailing and swaying swiftly and merrily up or down the face of a precipice, or across a mountain gorge with the roaring torrent brawling Heaven knows how many hair-raising thousands of feet below, until with a jerk and a click you arrive alongside of a narrow platform like the one you started from, climb out of your basket, walk across the platform, scramble into another basket, and off you go with a heave and a swoop on the next stage of your journey.

Where the cables can be securely braced, or supports can be slipped in at intervals, these flying bird-cages, these spider-trolleys can sail a mile or even a mile and a half at a stretch, but ordinarily they are laid out in flights of about half to three quarters of a mile, with a platform and station-house sheltering the gasoline engine, which drives the drum and supplies the motor power, at the end of each section.

As each section or unit of the line costs roughly about ten thousand dollars including price of gasoline-engine, cables, cars, and installation, though this last, of course, varies considerably with the location, and as each car will carry six hundred pounds and can be run at about two minutes' intervals

(headway), they are not an expensive form of transportation. Indeed, in that sort of country and by comparison with the cost of carrying by pack-mules and trails, they are remarkably cheap. And where time is a consideration they are literally "out of sight" of the pack-trains. For instance, the series of five mortal risks by which I sailed from the valley up to the glacier, eleven thousand feet, on Monte Adamello, in the Trentino, landed me gasping on the eternal snow in a little less than an hour and a quarter, while the same climb on mule-back would have taken eight and a half, and with pack-mules fourteen hours.

The flying tea-tray could make almost twelve trips while the pack-mules were making one. But it's a gulpy and giddy sort of "proposition" at first. You walk into the little shed station, where your big military motor has dropped you after a nerve-testing climb up extraordinary zigzags and around extremely unprotected corners, with as brave and nonchalant an air as possible, and cast a glance at the shiny twin cables that go sweeping up to your first landing-perch on a shelf twelve hundred feet above you.

So far, so good. They look as if they *might* hold you up — if nothing went wrong. Then you turn around and look for your car, expecting to see something resembling a small elevator-cage, or at least a deep-seated basket into which you could snuggle

down and fasten the cover over the top of you. But you see nothing of the sort, and finally you ask where it is and your officer-guide, politely struggling to hide a smile, points it out to you right under your very feet. And there, lying close alongside of the little twelve by six platform, is a ghastly little tea-tray of a thing about the shape and solidity of one of these little wire-mesh baskets that run along the ceiling and bring you back your parcels and change in a department store — only smaller!

As a matter of fact, it is about six feet long, three feet wide, by six inches deep, though it looks to your horror-stricken eyes of about the dimensions of a pen-tray, or one of these baskets on a desk in which "incoming" or "answered" letters are kept.

The bottom is solid, thank God, but the blithering six-inch sides are all perforated open-work, which makes them look about as solid and protective as a strip of mosquito-netting. But it was the ends that gave you palpitation of the heart. They were on hinges and were laid back wide open, as the car had just been carrying lumber.

When I could get my breath, I jerked out: "For Heaven's sake, shut those end-gates!" And we were to swoop up the mountain-side in that magnified pie-pan, without even a crust over us, and nothing whatever above us or on either side in the way of support or protection but that single spider-web cable

against the blue, blue sky and the iron fork which hung us from our trolley-wheel above.

I don't mind confessing that I played "Safety First" and lay flat on my back on that flying cot trying to dig my shoulder blades into the floor underneath, and gazing hopefully up into the blue sky to try and forget the six hundred feet of empty space which came between me and the rocks and trees below.

But on the second stage I ventured to lift my head and cautiously peek over the six-inch rail into the depths beneath. On the third I sat up and began to admire the scenery, and by the fourth I had to be cautioned not to hold my head so high when I was going under the "low bridge" arch of an extra support. After that I was ready to skate off anywhere on a "teleferica," and was only inclined to regret that they could n't be used on the level in the dull world below.

Really the motion is distinctly pleasant, and the sensation of sweeping free through the air quite exhilarating, after you once get over the first feeling of awkwardness and can forget to think about what might happen if the cable broke or an enemy shell hit it or your trolley ran off or the hauling line snapped. Also my guide informed me that in the event of a sudden squall of wind, quite common among those mountains, the cable would get to swaying so vio-

lently that it was n't safe for the engine to wind up any further on the line for fear of breakages, and you just had to stay out there and swing back and forth, pendulum fashion, until you gradually "cat-died" to rest again and could be hauled on up to the top. The second party before us had been caught in just such a squall and had done the "Rock-a-bye-baby" act for nearly an hour and a half before it was safe to haul them on again.

Another thing which caught my anxious and inquiring eye was the utter absence of anything in the slightest degree resembling a brake on the machine. I asked my officer-guide and he replied, with a reassuring smile, "Oh, it is unnecessary, quite unnecessary, Signore." "Oh, I see, we could grab the cable with our hands and hold ourselves, could n't we?" "Have no fear, Signore, have no fear," he smiled again, "if the drum line should ever break, nothing under the blue heaven could stop us until we arrived at the platform below, and of that, of course, we should know nothing. So why worry about such a trifle as the absence of a brake?"

But one soon learns to forget such considerations as these and to console one's self with the comforting practical thought that as a matter of fact the lines are so well built and the cables so carefully woven and tested that there have been surprisingly few fatal or serious accidents on these "teleferica"

lines. Though I never got to feel quite comfortable coasting with both end-gates down, especially the lower one, which I once discovered just as we had swooped about a hundred feet below the perch.

But they are God's mercy to the poor wounded, who fall on the glaciers or on the high mountain-slopes. In fact no other method of transportation whatever can compare with these flying cots in smoothness, swiftness, and utter absence of jolt or jar or unpleasant movement of any description.

They had done yeoman service only about six weeks before my visit, bringing down over six hundred from the battle of Corne Caventi, fought in trenches cut in the solid glacier ice, nearly thirteen thousand feet above the sea.

But this battle above the clouds was fought some three miles beyond the highest Alpine garrison post and seven miles of crevasse-seamed glacier surface lay between its trenches and the topmost platform of the last "teleferica." How were the wounded to be transported across this gap? By the last and most picturesque of ambulances on this romantic front, Eskimo-dog sledges, each drawn by two big woolly "huskies," or, as the Alaskans say, "malamoots."

A rough sledge-track was broken out and trampled down across the humpy and rolling surface of the glacier, which looked much as if a rather dirty ocean, with a choppy sea on, had suddenly been frozen

stiff. Though it wound in and out to avoid the worst of the bottomless cracks, which criss-crossed the glacier in every direction and surged up and down over the long swells of the frozen sea, the sledges would ride over it without many serious or troublesome jolts or jerks, so that the wounded, well bandaged and wrapped up, made the crossing in comparative comfort and were safely delivered at the topmost platform of the "teleferica."

From this they were lifted without change or disturbance, still in their stretchers, right into the steel basket, and were shot gently and swiftly downward with only one "change of cars," and even then the Pullman berths went right through, to the Refugio Garibaldi, the highest, if not the greatest, hospital in the world, perched on a little valley shelf among the peaks and above a precipice nine thousand feet in air. Here they were carefully looked over by the surgeons to see that everything was all right and ship-shape about the dressings, and those who were in serious or critical condition from wounds in the head, abdomen, etc., were taken directly to the Hospital, operated upon, and kept in comfortable wards until they were able to travel on down to the valley.

There were only about twenty of these bandaged heroes left in the Hospital at the time of my visit, and they were all convalescent, the others having recovered and been sent on down the mountain. They

looked very comfortable and happy sitting and lounging on the green slope between the Hospital and a tiny lake in the saucer of the wee valley, and were formally presented to me by the young surgeon in charge as "the blesseds of the Adamello," which they certainly were and looked.

For the more lightly wounded it is only three more swoops and a four-mile roll in a big motor ambulance over perfect roads down to the Field Hospitals in the villages of the upper valley or a ten-mile one to the big Base Hospitals in the bustling town among the meadows in the main valley below.

These dog-teams and sledges were in constant use up on the glacier as the chief means of transportation for all sorts of supplies from the main post at the top of the "teleferica" to the advanced garrison outpost three miles away across the glacier: partly on account of the difficulty and expense of hauling up the bulky fodder and grain, which would have been needed for mules or ponies, but more on account of the narrow and constantly shifting trails across the dangerous crevasses of the glacier. The whole surface of the glacier was seamed on an average about every hundred yards with these perilous fissures, most of them fortunately only six inches to a couple of feet in width, but if you looked down into them as your sledge was being dragged across them, you gazed into steely blue depths that made you shiver.

As my officer-guide facetiously remarked, just after crossing one of them, which was fully half as wide as my sled-runners were long: "If you wish to become immortal, Signor Dottore, all you have to do is to plunge in there. You will be beautifully preserved in cold storage for perhaps two hundred years and then reappear to the admiring public eye, as natural as life, at the foot of the glacier below." I said I would think about it later when all other hopes of leaving anything to be remembered by had failed.

But these children of the high Alps don't let little things like that worry them in the least; as long as the crevasses across the trail are not more than eighteen inches wide, so as to be bridged by the runners of the dog-sledges with a foot to spare at each end, they pay no attention to them, but just ride straight across.

When they open to a width of two feet or more, they take two or three planks or the top of a packing-case, lay it across the crevasse, shovel a little snow on it to make it good sledding, and then the traffic goes merrily on over. If the crack gets to be two yards or more wide, then they will go the length of a little wooden bridge of inch boards with a hand-rail on one side. Over the rail of one such massive structure we could actually look down into a huge, violet, cathedral-shaped ice cavern, as big as the Grand Central Station, along the peak of whose roof ran our cre-

vasse and hear the brawling of the glacier stream eight hundred feet below.

The only animals that can be got to walk across structures like that are dogs and men — mules have too much sense. Nor was the danger of the roof of the Grand Central Station yawning and swallowing you up purely imaginary. At the main garrison-post they showed us great caverns which had opened in the ice, beginning as mere two-inch cracks, right in under the side of one of the barracks and the end of another, so that they had to be perpetually on the lookout and ready to move to another and as yet safer site. The gulf that had opened under the end of an abandoned cook-house was already thirty feet across and of a depth that ended in a floor of blue haze.

This was the reason why they used those curious shack-like hut shelters up in that region of intense cold, because they would straddle lightly over the surface and were too long to fall into any crevasse which was likely to open suddenly, and also could be quickly pulled down and moved to safer ground, or even snaked along the surface of the ice.

The dogs had a special big barrack of their own, just as tight and comfortable as those of the soldiers. There were between fifty and sixty of them — great, big, handsome fellows — with thick, wavy or shaggy coats and long, wolf-like tails, looking like a cross

between a rough-coated St. Bernard and a big hairy collie. As a lifelong dog-lover and breeder, I inquired at once as to their blood, but was told that they were of no particular breed, just the dogs used by the shepherds and herdsmen in the High Tyrol.

Possibly they were also related to the famous dogs of the St. Bernard Pass, who, however, were probably developed from a similar if not a common stock. In fact the head-keeper, when asked if they were n't part St. Bernard, replied with a shrug of the shoulders, "Ah, yes, perhaps; but perhaps the St. Bernards are half them!" — clearly of the opinion that there were other famous dogs in the world besides those of the great monastery.

I was greatly amused to find that these devoted and much-petted dogs were not only treated, but also fed, like human beings. They were given macaroni and soup and rice, with great ladlefuls of beans, flavored with cheese or dried fish. All these were dished out hot and smoking, one after another, into great soup platters, such as the soldiers use, laid the whole length of their comfortable kennel hut, between two eagerly waiting lines of hungry dogs. They sat up at strict attention, without a sound, though with slobbering lips, until the last ladleful had been dished out. Then at a sharp word of command from the chief driver they sprang forward, like a shot, and cleaned

ITALIAN WAR DOGS

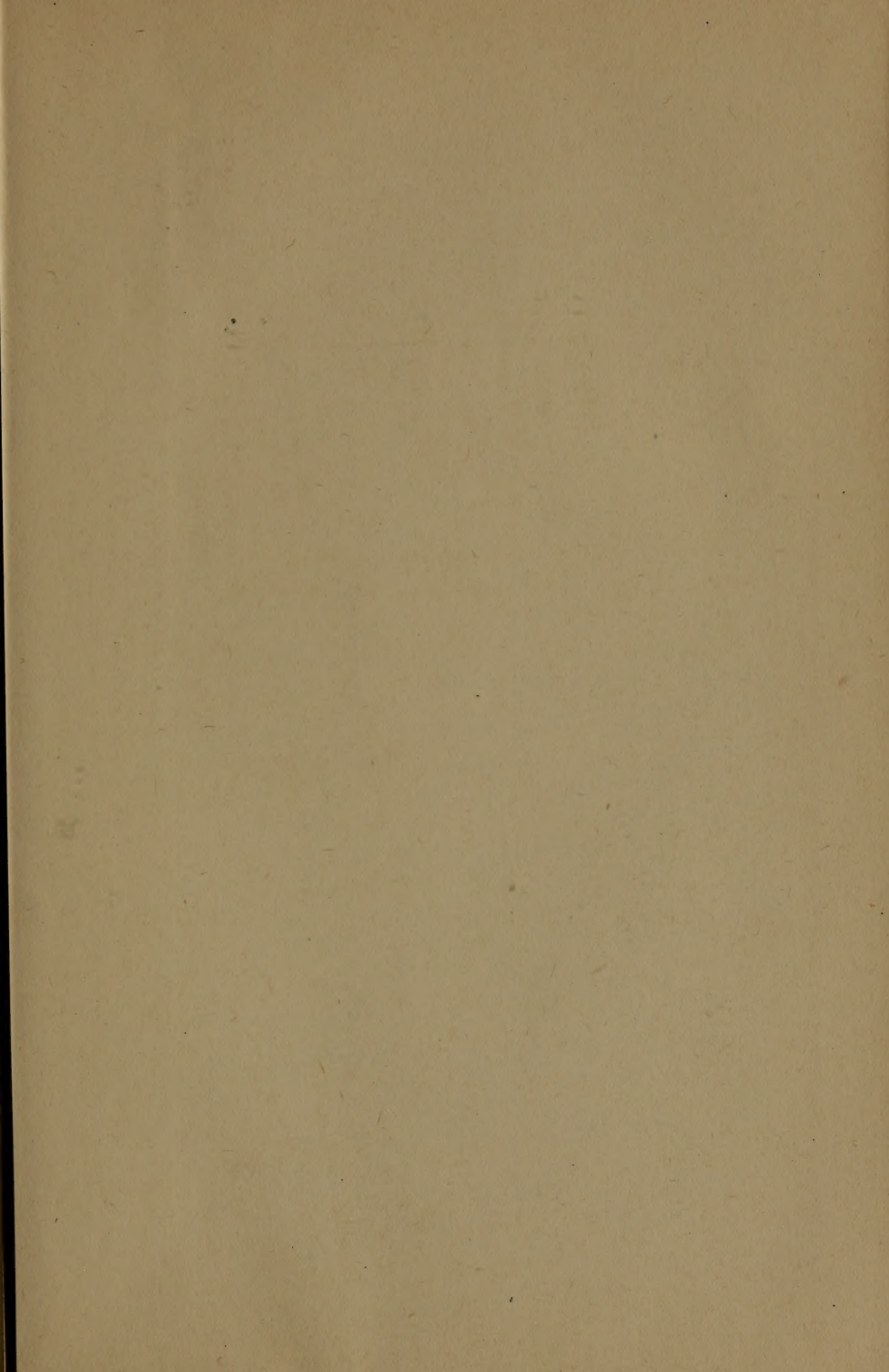


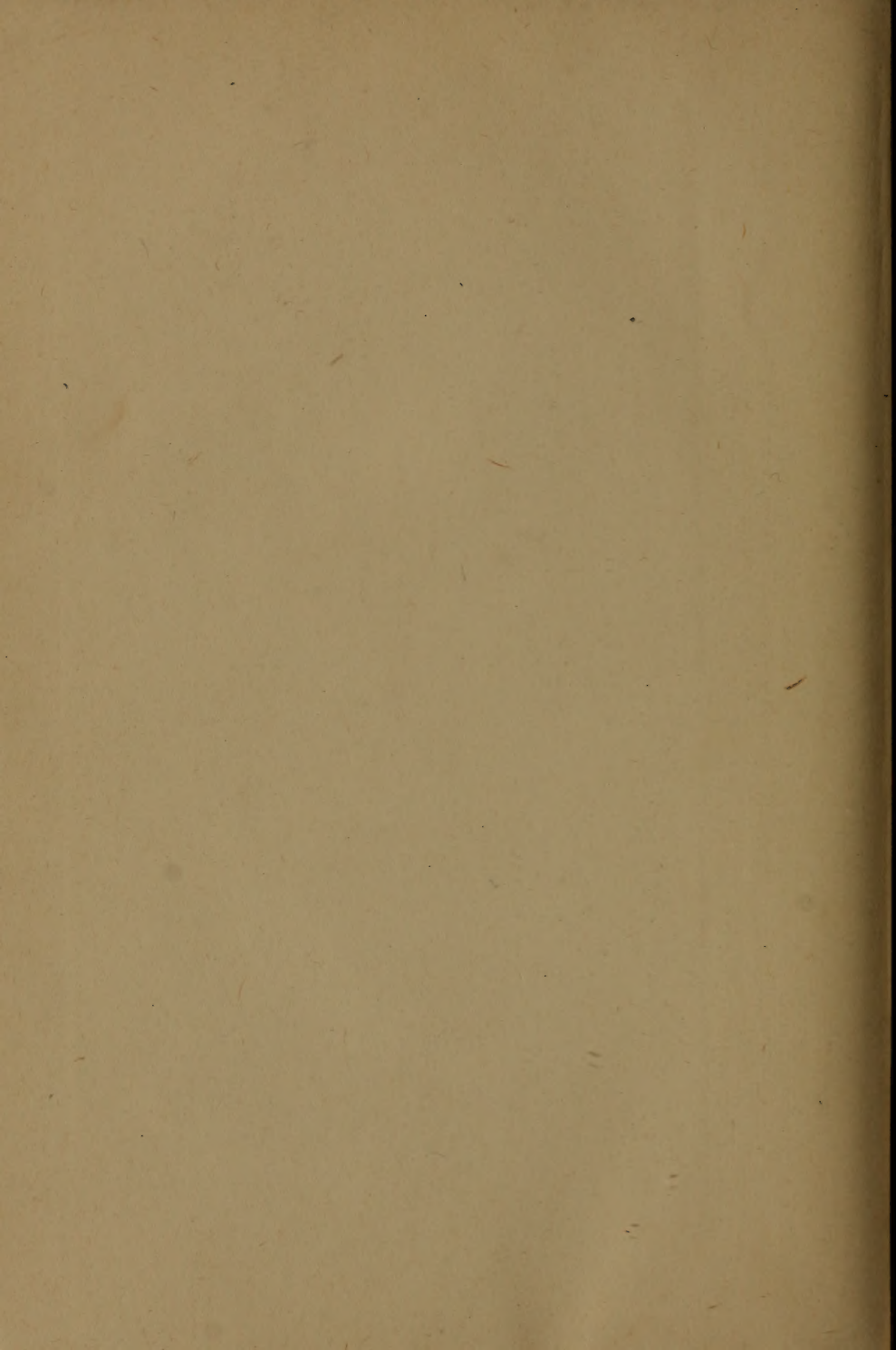
up every platterful to the last drop with gleeful gobblings.

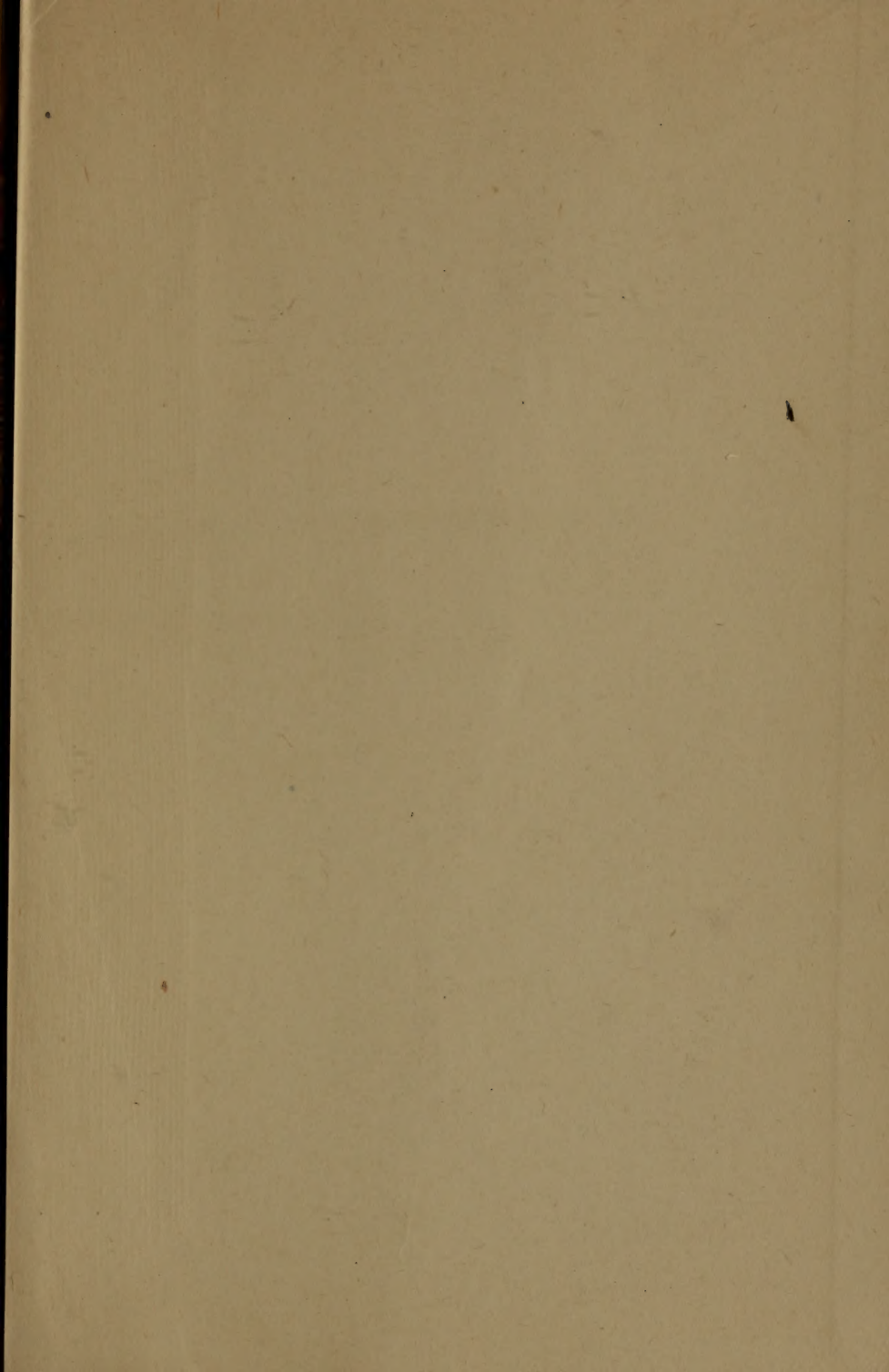
The Alpini Commandant assured me that they could not keep their strength and endurance on any less choice and nourishing food; indeed, the expense of transportation up to that high altitude, twelve thousand feet above sea level, was so great that it was not worth while bringing up any except the best and most concentrated foods. To crown all, he informed me that the head driver, who loved them like children, insisted that the dogs actually needed a small "shot" of hot coffee, with condensed milk and sugar in it, every morning just to warm up their stomachs against the bitter mountain cold, for the day's work; just as the soldier thinks the world of his thimbleful of hot rum in the early dawn in the trenches, especially before he goes over the top. Dogs are very much like men and both extremely human, after all.

THE END

The Riverside Press
CAMBRIDGE . MASSACHUSETTS
U . S . A







LIBRARY OF CONGRESS



0 022 216 240 3